Volume II
Appendix D.3
Fault Tree Closure Summary

The NASA Accident Investigation Team examined the accident using "fault trees," a common organizational tool in systems engineering. Fault trees are graphical representations of every conceivable sequence of events that could cause a system to fail. The fault tree's uppermost level illustrates the events that could have directly caused the loss of Columbia by aerodynamic breakup during re-entry. Subsequent levels comprise all individual elements or factors that could cause the failure described immediately above it. In this way, all potential chains of causation that could have ultimately led to the loss of *Columbia* can be diagrammed, and the behavior of every subsystem that was not a precipitating cause can be eliminated from consideration.

NASA chartered six teams to develop fault trees, one for each of the Shuttle's major components: the Orbiter, Space Shuttle Main Engine, Reusable Solid Rocket Motor, Solid Rocket Booster, External Tank, and Payload. A seventh "systems integration" fault tree team analyzed failure scenarios involving two or more Shuttle components. These interdisciplinary teams included NASA and contractor personnel, as well as outside experts. Some of the fault trees are very large and intricate. For instance, the Orbiter fault tree, which only considers events on the Orbiter that could have led to the accident, includes 234 elements. In contrast, the Systems Integration fault tree, which deals with interactions among parts of the Shuttle, includes 295 unique multi-element integration faults, 128 Orbiter multi-element faults, and 221 connections to the other Shuttle components.

This appendix provides a listing of fault tree elements that were investigated by the Board and closed during the *Columbia* investigation. Some of the elements in this appendix were open at the time the investigation concluded, but are expected to be closed before the Return to Flight. Items marked "Open due to lower element" remained open because a lower level fault tree had yet to be closed; for the most part, the lower-level fault trees are contained in Appendix D.4.

Fault Tree Closure Summary

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Note: Some of the element closures will extend beyond the writing of this report. In addition, there are some elements that can never be closed as neither data nor analysis can unambiguously rule out a contribution to the Columbia accident. Those are listed and described in Appendix D.4. This appendix contains the fault tree elements that were closed by the Columbia Accident Investigation Board as well as the open fault tree elements that have closure strategies and are expected to be closed.

SECTION A

– *Not Reviewed by CAIB, expected closure as 'not a contributor '*

– *Reviewed and closed by CAIB as 'not a contributor'*

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
AC	AERODYNAMIC BREAKUP DUE TO IMPROPER ATTITUDE / TRAJECTORY CONTROL
ACCF	IMPROPER ATTITUDE/TRAJECTORY CONTROL DUE TO COMMAND FAILURE
ACCF-CALC	COMMAND FAILURE DUE TO INCORRECT CALCULATION
ACCF-CALC-5-01	INCORRECT CALCULATION DUE TO NAVIGATION ERROR
ACCF-CALC-5-02	INCORRECT CALCULATION DUE TO GUIDANCE ERROR
ACCF-CALC-5-03	INCORRECT CALCULATION DUE TO FLIGHT CONTROL ERROR
ACCF-CALC-6-01	NAV ERROR DUE TO IMU FAILURE
ACCF-CALC-6-02	NAV ERROR DUE TO BAD NAV STATE UPLOAD
ACCF-CALC-6-03	NAV ERROR DUE TO SOFTWARE ERROR
ACCF-CALC-6-04	GUIDANCE ERROR DUE TO BAD I-LOAD
ACCF-CALC-6-05	GUIDANCE ERROR DUE TO BAD LOGIC
ACCF-CALC-6-06	FLIGHT CONTROL ERROR DUE TO RATE SENSOR FAILURE

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
ACCF-CALC-6-07	FLIGHT CONTROL ERROR DUE TO ACCELEROMETER FAILURE
ACCF-CALC-6-08	FLIGHT CONTROL ERROR DUE TO FC SOFTWARE ERROR
ACCF-CALC-6-09	GUIDANCE SOFTWARE ERROR DUE TO BAD DEORBIT BURN TARGET UPLOAD
ACCF-CALC-7-01	SOFTWARE ERROR DUE TO BAD I-LOAD
ACCF-CALC-7-02	SOFTWARE ERROR DUE TO BAD LOGIC
ACCF-CALC-7-03	FC SOFTWARE ERROR DUE TO BAD I-LOAD
ACCF-CALC-7-04	FC SOFTWARE ERROR DUE TO BAD LOGIC
ACCF-SIG	COMMAND FAILURE DURING DATA PROCESSING TRANSMISSION
ACCF-SIG-5-01	DATA P/T ERROR DUE TO GPC FAILURE
ACCF-SIG-5-02	DATA P/T ERROR DUE TO BROKEN WIRE
ACCF-SIG-5-03	DATA P/T ERROR DUE TO MDM FAILURE
ACCF-SIG-5-04	DATA P/T ERROR DUE TO EMI (ME)
ACCF-SIG-6-01	EMI CAUSED BY INTERNAL SOURCE
ACCF-SIG-6-02	EMI CAUSED BY EXTERNAL SOURCE
ACCF-SIG-6-06	HARDWARE FAILURE CAUSES GPC FAILURE
ACCF-SIG-6-07	SOFTWARE FAILURE CAUSES GPC FAILURE
ACCF-SIG-6-08	HARDWARE FAILURE CAUSES MDM FAILURE
ACCF-SIG-6-09	FIRMWARE ERROR CAUSES MDM FAILURE
ACCG	VEHICLE CONFIGURATION OUTSIDE ENVELOPE DUE TO CENTER OF GRAVITY (CG) (ME)
ACCG-CG	INCORRECT CENTER OF GRAVITY
ACCG-INER	INCORRECT MOMENTS OF INERTIA
ACCG-WT	INCORRECT WEIGHT
ACEF	IMPROPER ATTITUDE/ TRAJECTORY CONTROL DUE TO CONTROL EFFECTOR FAILURE
ACEF-AE	CONTROL EFFECTOR FAILURE DUE TO AEROSURFACE FAILURE
ACEF-AE-5-01	AEROSURFACE FAILURE DUE TO ELEVON FAILURE
ACEF-AE-5-02	AEROSURFACE FAILURE DUE TO RUDDER / SPEED BRAKE FAILURE
ACEF-AE-5-03	AEROSURFACE FAILURE DUE TO BODY FLAP FAILURE
ACEF-AE-6-01	ELEVON FAILURE DUE TO DEBRIS
ACEF-AE-6-02	ELEVON FAILURE DUE TO ACTUATOR FAILURE (INCLUDING ASA)

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
ACEF-AE-6-03	R/S FAILURE DUE TO DEBRIS
ACEF-AE-6-04	RUDDER/SPEEDBRAKE FAILURE DUE TO ACTUATOR FAILURE (INCLUDING ASA)
ACEF-AE-6-05	BODY FLAP FAILURE DUE TO DEBRIS
ACEF-AE-6-06	BODY FLAP FAILURE DUE TO ACTUATOR FAILURE (INCLUDING ASA)
ACEF-AE-7-01	ACTUATOR FAILURE DUE TO ELECTRICAL POWER/DISTRIBUTION FAILURE
ACEF-AE-7-02	ACTUATOR FAILURE DUE TO APU/HYDRAULICS FAILURE (ME)
ACEF-AE-7-03	ACTUATOR FAILURE DUE TO ELECTRICAL POWER/DISTRIBUTION FAILURE
ACEF-AE-7-04	ACTUATOR FAILURE DUE TO APU/HYDRAULICS FAILURE
ACEF-AE-7-05	ACTUATOR FAILURE DUE TO ELECTRICAL POWER/DISTRIBUTION FAILURE
ACEF-AE-7-06	ACTUATOR FAILURE DUE TO APU/HYDRAULICS FAILURE (ME)
ACEF-AE-7-07	MECHANICAL FAILURE OF ELEVON ACTUATOR
ACEF-AE-7-08	MECHANICAL FAILURE OF R/S ACTUATOR
ACEF-AE-7-09	MECHANICAL FAILURE OF BODY FLAP
ACEF-AE-7-10	SSME CONTACTS BODY FLAP (ME)
ACEF-OMS	CONTROL EFFECTOR FAILURE DUE TO OMS FAILURE
ACEF-RCS	CONTROL EFFECTOR FAILURE DUE TO RCS JET FAILURE
ACEF-RCS-5-1	RCS JETS FAIL TO BURN WHEN COMMANDED CAUSES LOSS OF ATTITUDE
ACEF-RCS-5-2	RCS JETS BURN INCORRECTLY WHEN COMMAND CAUSES LOSS OF ATTITUDE
SFOML-AFT	LOSS OF OML DUE TO AFT FUSELAGE FAILURE
SFOML-BAY	LOSS OF OML DUE TO PAYLOAD BAY DOOR FAILURE
SFOML-CABIN	LOSS OF OML DUE TO CREW CABIN MODULE FAILURE
SFOML-FLAP	LOSS OF OML DUE TO BODY FLAP FAILURE
SFOML-FRCS	LOSS OF OML DUE TO FRCS STRUCTURAL FAILURE
SFOML-FWD	LOSS OF OML DUE TO FWD FUSELAGE FAILURE
SFOML-INTPLB	LOSS OF OML DUE TO FAILURE SOURCE INTERNAL TO PAYLOAD BAY
SFOML-MID	LOSS OF OML DUE TO MID FUSELAGE FAILURE
SFOML-OMS	LOSS OF OML DUE TO OMS POD FAILURE
SFOML-SSME	LOSS OF OML DUE TO SSME OUT OF CONFIGURATION (ME)
SFOML-TAIL	LOSS OF OML DUE TO TAIL FAILURE

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
SFOML-WINDOW	LOSS OF OML DUE TO WINDOW FAILURE
SFOML-WING-5-1	WING/ELEVON STRUCTURAL FAILURE DUE TO WING OVERLOAD
SFOML-WING-5-2	WING/ELEVON STRUCTURAL FAILURE DUE TO OVERPRESSURIZATION OR COLLAPSE
SFOML-WING-5-4	WING/ELEVON STRUCTURAL FAILURE DUE TO WEAKENED WING STRUCTURE
SFOML-WING-6-1	WING OVERLOAD DUE TO FLIGHT OUTSIDE ENVELOPE (ME)
SFOML-WING-6-2	WING OVERLOAD DUE TO INTEGRATED ENVIROMENT DIFFERENT THAN DESIGN
SFOML-WING-6-3	WING OVERLOAD DUE TO IMPROPER VEHICLE CONFIGURATION
SFOML-WING-6-4	WING OVERLOAD DUE TO WING/ELEVON FLUTTER
SFOML-WING-6-5	WING OVERPRESS OR COLLAPSE DUE TO BLOCKED VENT RESULTING IN FAILURE TO REPRESS
SFOML-WING-6-6	WING OVERPRESS. OR COLLAPSE DUE TO PRESSURE SYSTEM FAILURE CAUSING INADVERTENT PRESSURIZATION
SFOML-WING-6-7	WING OVERPRESS OR COLLAPSE DUE TO BLOWN TIRE CAUSING INADVERTENT PRESSURE
SFOML-WING-6-8	THERMAL DAMAGE BURN THROUGH DUE TO HIGHER HEATING
SFOML-WING-6-9	OVERHEAT/ THERMAL DAMAGE/ BURN THROUGH DUE TO INADVERTENT OPENING IN WING ALLOWING PLASMA FLOW
SFOML-WING-6-11	WEAKENED WING STRUCTURE DUE TO FATIGUE FAILURE IN WING/ELEVON
SFOML-WING-6-12	WEAKENED WING STRUCTURE DUE TO STRUCTURE CONFIGURATION NOT PER DESIGN STRENGTH
SFOML-WING-6-13	WEAKENED WING STRUCTURE DUE TO SPACE ENVIRONMENT (“Space Weather”)
SFOML-WING-6-14	WEAKENED WING STRUCTURE DUE TO PLASMA/ELECTRICAL DISCHARGE
SFOML-WING-6-15	WEAKENED WING STRUCTURE DUE TO INTERNAL FIRE (ME)
SFOML-WING-6-16	WEAKENED WING STRUCTURE DUE TO MMOD
SFOML-WING-6-18	WING OVERPRESS OR COLLAPSE DUE TO PAYLOAD BAY SOURCE (ME)
SFOML-WING-7-1	FLIGHT OUTSIDE ENVELOPE DUE TO MISSION DESIGN ERROR
SFOML-WING-7-2	FLIGHT OUTSIDE ENVELOPE DUE TO FLIGHT CONTROL SURFACE LOAD PATH
SFOML-WING-7-3	FLIGHT OUTSIDE ENVELOPE DUE TO OVERWEIGHT / CENTER OF GRAVITY OUT OF LIMITS
SFOML-WING-7-5	IMPROPER WING CONFIGURATION DUE TO EARLY GEAR DEPLOYMENT (ME)
SFOML-WING-7-7	WING/ELEVON FLUTTER DUE TO CHANGE IN AIR FLOW
SFOML-WING-7-8	WING/ELEVON FLUTTER DUE TO HIGHER SPEED THAN PLANNED
SFOML-WING-7-9	WING/ELEVON FLUTTER DUE TO IMPROPER MASS PROPERTIES
SFOML-WING-7-10	WING/ELEVON FLUTTER DUE TO FCS LINKAGE FAILURE
SFOML-WING-7-11	WING/ELEVON FLUTTER DUE TO LOOSE COMPONENT

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
SFOML-WING-7-12	INADVERTENT PRESSURIZATION DUE TO PRSD/ECLSS TANK FAILURE
SFOML-WING-7-13	INADVERTENT PRESSURIZATION DUE TO OTHER EVENT
SFOML-WING-7-14	HIGHER HEATING DUE TO OFF NOMINAL TRAJECTORY
SFOML-WING-7-15	HIGHER HEATING DUE TO UNEXPECTED FLOW
SFOML-WING-7-16	HIGHER HEATING DUE TO UNUSUAL ENVIRONMENT
SFOML-WING-7-17	HIGHER HEATING DUE TO HEAVY ENTRY WEIGHT
SFOML-WING-7-18	INADVERTENT DOOR OPEN OR BREACH OF THERMAL SEAL (GEAR REMAINS UP)
SFOML-WING-7-19	INADVERTENT OPENING IN WING ALLOWING PLASMA FLOW DUE TO FLIPPER DOOR FAILURE
SFOML-WING-7-21	TPS MALFUNCTION DUE TO TILE FAILURE
SFOML-WING-7-22	TPS MALFUNCTION DUE TO BLANKET FAILURE
SFOML-WING-7-23	TPS MALFUNCTION DUE TO SEAL FAILURE
SFOML-WING-7-24	FATIGUE FAILURE IN WING/ELEVON DUE TO DEGRADED PROPERTIES
SFOML-WING-7-25	FATIGUE FAILURE IN WING/ELEVON DUE TO SPECTRA EXCEEDED CERTIFICATION PREVIOUS FLIGHT
SFOML-WING-7-26	FATIGUE FAILURE IN WING/ELEVON DUE TO FRACTURE CRITICAL ITEM
SFOML-WING-7-27	STRUCTURE CONFIGURATION NOT PER DESIGN STRENGTH DUE TO LOADS EXCEED PREVIOUS FLIGHTS (ME)
SFOML-WING-7-28	STRUCTURAL CONFIGURATION NOT PER DESIGN STRENGTH DUE TO DEGRADED STRUCTURAL PROPERTIES
SFOML-WING-7-29	STRUCTURE CONFIGURATION NOT PER DESIGN CERTIFICATION DUE TO UNDETECTED NEGATIVE MARGINS
SFOML-WING-7-30	STRUCTURE CONFIGURATION NOT PER DESIGN
SFOML-WING-7-31	MICRO METEROID
SFOML-WING-7-32	ORBITAL DEBRIS
SFOML-WING-7-35	ENTRY LOADS OUTSIDE CERTIFICATION (ME)
SFOML-WING-7-36	INTEGRATED VEHICLE ASCENT ENVIRONMENT OUT OF FAMILY (ME)
SFOML-WING-7-37	ON-ORBIT LOADS OUTSIDE CERTIFICATION (ME)
SFOML-WING-7-38	GROUND PROCESSING INDUCED LOADS OUT OF CERTIFICATION (ME)
SFOML-WING-7-39	FERRY FLIGHT INDUCED LOADS OUTSIDE CERTIFICATION
SFOML-WING-7-40	ON-ORBIT PLASMA/ELECTRICAL DISCHARGE
SFOML-WING-7-41	ENTRY PLASMA/ELECTRICAL DISCHARGE
SFOML-WING-8-1	STS-107 ORBITER LOADS
SFOML-WING-8-7	UNEXPECTED FLOW DUE TO EARLY TRANSITION (STEP/GAP)

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
SFOML-WING-8-8	UNEXPECTED FLOW DUE TO AERO PHENOMENA (ASYMMETRIC TRANSITION SHOCK WAVE)
SFOML-WING-8-9	UNEXPECTED FLOW DUE TO CHEMISTRY OR MATERIALS PROBLEM (CATALYSIS OR CONTAMINATION)
SFOML-WING-8-11	RCC FAILURE DUE TO CRACK/HOLE < 0.25 IN ON BOTTOM 1.0 IN ON TOP NOT SIGNIFICANT
SFOML-WING-8-12	RCC FAILURE DUE TO DEGRADED COATING EXPOSES RCC SUBSTRATE
SFOML-WING-8-13	RCC FAILURE DUE TO ENVIRONMENT OUTSIDE RCC CERTIFICATION ("SPACE WEATHER")
SFOML-WING-8-15	TILE FAILURE DUE TO TILE DEBOND
SFOML-WING-8-16	TILE FAILURE DUE TO BROKEN TILE
SFOML-WING-8-17	TILE FAILURE DUE TO FAILED REPAIR
SFOML-WING-8-18	TILE FAILURE DUE TO LOST CARRIER PANEL
SFOML-WING-8-19	BLANKET FAILURE DUE TO BLANKET INTEGRITY LOSS
SFOML-WING-8-20	BLANKET FAILURE DUE TO LOST CARRIER PANEL
SFOML-WING-8-21	BLANKET FAILURE DUE TO DEBOND
SFOML-WING-8-22	SEAL FAILURE DUE TO THERMAL BARRIER FAILURE
SFOML-WING-8-23	SEAL FAILURE DUE TO ELEVON COVE SEAL FAILURE
SFOML-WING-8-24	SEAL FAILURE DUE TO ENVIRONMENTAL SEAL FAILURE
SFOML-WING-8-25	FATIGUE FAILURE DUE TO CORROSION
SFOML-WING-8-26	FATIGUE FAILURE DUE TO FRACTURE TOUGHNESS DEGRADATION
SFOML-WING-8-27	STS-109/PAST ORBITER ASCENT SPECTRUM (ME)
SFOML-WING-8-28	STS-109/PAST ORBITER ON-ORBIT SPECTRUM (ME)
SFOML-WING-8-29	STS-109/PAST ORBITER DESCENT SPECTRUM (ME)
SFOML-WING-8-30	FAILURE OF <100 FLIGHT LIFE FRACTURE CRITICALITY ITEM
SFOML-WING-8-31	FAILURE OF FRACTURE CRITICALITY ITEM OF 100 TO 300 FLIGHT LIFE
SFOML-WING-8-32	PREVIOUS STS-109/ORBITER DESCENT LOADS
SFOML-WING-8-33	PREVIOUS STS-109/ORBITER ASCENT LOADS
SFOML-WING-8-34	PREVIOUS STS-109/ORBITER ON ORBIT LOADS
SFOML-WING-8-35	DEGRADED STRENGTH DUE TO CORROSION
SFOML-WING-8-36	DEGRADED STRENGTH FROM TEMPERATURE EXPOSURE
SFOML-WING-8-37	DEGRADED STRENGTH DUE TO CREEP
SFOML-WING-8-38	ANALYSIS MISSED ON LOW SAFETY MARGIN (M.S. < 0.20) ITEM

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
SFOML-WING-8-39	ANALYSIS MISSED DEFLECTIONS CRITICAL TO TPS
SFOML-WING-8-40	PROCEDURAL ERRORS
SFOML-WING-8-41	INCORRECT DISPOSITION OF BUILD MR OR STS-109 AND STS-107 FROM PR
SFOML-WING-8-42	TILE FAILURE DUE TO FLIGHT OUTSIDE CERTIFIED ENVIRONMENT (ME)
SFOML-WING-8-44	BLANKET LOSS DUE TO FLIGHT OUTSIDE CERTIFIED ENVIRONMENT (ME)
SFOML-WING-8-46	PRSD RUPTURE OR FIRE/EXPLOSION
SFOML-WING-8-47	ECLSS TANK FAILURE
SFOML-WING-8-48	LEAKS PRIOR TO FLIGHT
SFOML-WING-8-49	SPILLS PRIOR TO FLIGHT
SFOML-WING-8-50	INFLIGHT LEAKS
SFOML-WING-8-52	UNEXPECTED FLOW DUE TO ASYMMETRICAL BOUNDRY LAYER TRANSITION
SFOML-WING-8-53	RCC FAILURE DUE TO IMPROPER RCC REPAIR
SFOML-WING-9-1	HEAVY WEIGHT HEAVE ENTRY WT CAUSED SF OF OML SING/ELEVON (ME)
SFOML-WING-9-2	OTHER
SFOML-WING-9-12	DEGRADED COATING EXPOSES RCC SUBSTRATE DUE TO PINHOLES
SFOML-WING-9-13	DEGRADED COATING EXPOSES RCC SUBSTRATE DUE TO CONTAMINATION
SFOML-WING-9-14	DEGRADED COATING EXPOSES RCC SUBSTRATE DUE TO IMPACT
SFOML-WING-9-15	DEGRADED COATING EXPOSES RCC SUBSTRATE DUE TO ATOMIC OXYGEN DIATOMIC OXYGEN
SFOML-WING-9-16	DEGRADED COATING EXPOSES RCC SUBSTRATE DUE TO AGING
SFOML-WING-9-17	DEGRADED COATING EXPOSES RCC SUBSTRATE DUE TO IMPROPER COATING REPAIR
SFOML-WING-9-21	LOSS OF RCC PANEL DUE TO ADJACENT LOSS OF CARRIER PANEL
SFOML-WING-9-22	TILE DEBOND DUE TO IMPROPER INSTALLATION
SFOML-WING-9-23	TILE DEBOND DUE TO FAULTY BOND INTEGRITY
SFOML-WING-9-24	FASTENER FAILURE DUE TO SNEAK FLOW
SFOML-WING-9-25	TILE NOT WATER-PROOFED
SFOML-WING-9-26	ANALYSIS MISSED OUT-OF-PLANE DEFLECTION FOR TILE
SFOML-WING-9-27	LOST CARRIER PANEL DUE TO FAILED FASTENERS
SFOML-WING-9-28	LOST CARRIER PANEL DUE TO FLOW PENETRATING WING SEAL
SFOML-WING-9-29	BLANKET INTEGRITY LOST DUE TO FAILED REPAIR

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
SFOML-WING-9-30	DEBOND DUE TO IMPROPERLY INSTALLATION
SFOML-WING-9-31	DEBOND DUE TO BOND INTEGRITY FAILURE
SFOML-WING-9-32	THERMAL BARRIER FAILURE DUE TO LANDING GEAR THERMAL BARRIER FAILURE
SFOML-WING-9-33	THERMAL BARRIER FAILURE DUE TO ET UMBILICAL DOOR THERMAL BARRIER FAILURE
SFOML-WING-9-35	ENVIRONMENTAL SEAL FAILURE DUE TO LANDING GEAR DOOR FAILURE
SFOML-WING-9-36	ENVIRONMENTAL SEAL FAILURE DUE TO ET UMBILICAL DOOR FAILURE
SFOML-WING-9-37	DESCENT SPECTRA EXCEEDED CERTIFICATION PREVIOUS FLIGHT DUE TO CAUSES OTHER THAN WEIGHT
SFOML-WING-9-38	PAST HEAVY WEIGHT
SFOML-WING-9-39	OTHER LOADS EXCEEDING PREVIOUS FLIGHT CERTIFICATION
SFOML-WING-9-40	PREVIOUS FLIGHT HEAVY WEIGHT
SFOML-WING-9-41	STS-107 FLOW OPERATIONS IN WING
SFOML-WING-9-42	STS-109 OMM OPERATIONS IN WING
SFOML-WING-9-43	"USE AS IS" HARDWARE
SFOML-WING-9-44	MODIFIED HARDWARE
SFOML-WING-9-46	LANDING GEAR THERMAL BARRIER FAILURE DUE TO FLIGHT OUTSIDE ENVELOPE (ME)
SFOML-WING-9-47	ANALYSIS MISSED OUT-OF-PLANE DEFLECTION FOR TILE
SFOML-WING-9-53	IMPACT
SFOML-WING-9-54	IMPACT
SFOML-WING-9-56	IMPACT
SFOML-WING-9-57	IMPACT
SFOML-WING-9-58	TILE DEBOND DUE TO IMPROPER WATER PROOFING
SFOML-WING-9-59	DEGRADED COATING DUE TO ENVIRONMENTS (ME)
SFOML-WING-10-6	PRE LAUNCH UNIDENTIFIED IMPACT WHILE IN VEHICLE ASSEMBLY BUILDING (ME)
SFOML-WING-10-7	PRE LAUNCH UNIDENTIFIED IMPACT WHILE IN ORBITER PROCESSING FACILITY (ME)
SFOML-WING-10-8	SUPPORTING STRUCTURAL FAILURE DUE TO INTERNAL INSULATION FAILURE
SFOML-WING-10-9	WING LEADING EDGE STRUCTURE FAILURE
SFOML-WING-10-10	LOSS OF CARREIR PANEL DUE TO FASTENER FAILURE
SFOML-WING-10-11	LOSS OF CARRIER PANEL DUE TO FLOW PENETRATING WING SEAL
SFOML-WING-10-12	FAULTY BOND INTEGRITY DUE TO AGE

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
SFOML-WING-10-13	FAULTY BOND INTEGRITY DUE TO OTHER FLUIDS
SFOML-WING-10-14	FAILED FASTENERS DUE TO IMPROPER INSTALLATION
SFOML-WING-10-15	BOND INTEGRITY FAILURE DUE TO AGE
SFOML-WING-10-16	BOND INTEGRITY FAILURE DUE TO OTHER FLUIDS
SFOML-WING-10-17	LANDING GEAR T/B FAILURE DUE TO DEGRADATION OF THERMAL BARRIER MATERIAL
SFOML-WING-10-18	LANDING GEAR T/B FAILURE DUE TO INPROPER INSTALL / CLOSING
SFOML-WING-10-19	ET UMBILICAL DOOR T/B FAILURE DUE TO IMPROPER INSTALL / CLOSING
SFOML-WING-10-20	ET UMBILICAL DOOR T/B FAILURE DUE TO DEBRIS DURING CLOSING
SFOML-WING-10-21	ET UMBILICAL DOOR T/B FAILURE DUE TO THERMAL BARRIER FAILURE INSIDE LIFETIME
SFOML-WING-10-22	MID FUSELAGE SIDEWALL OIL CAN
SFOML-WING-10-23	WING / FUSELAGE ATTACHMENT BOLTS
SFOML-WING-10-24	UNSEALED BLIND RIVETS
SFOML-WING-10-26	OTHER
SFOML-WING-10-27	HARD LANDING
SFOML-WING-10-28	THIN STRUTS
SFOML-WING-10-29	ELEVON COVE LEAKAGE BLADE SEAL REWORK
SFOML-WING-10-30	CLAM - SHELL REPAIR STRUTS
SFOML-WING-10-31	UNSEATED BLIND RIVETS
SFOML-WING-10-32	FACILITY, GSE, SPECIAL TEST EQUIPMENT, TOOLING, AND OTHER HARDWARE
SFOML-WING-10-33	PRE LAUNCH UNIDENTIFIED IMPACT DURING TRANSPORTATION (SCA, ORBITER TRANSPORTER) (ME)
SFOML-WING-10-35	ET UMBILICAL DOOR T/B FAILURE DUE TO FLIGHT OUTSIDE CERTIFIED ENVIRONMENT (ME)
SFOML-WING-10-36	SPILLS
SFOML-WING-10-48	IMPACT
SFOML-WING-10-49	IMPACT
SFOML-WING-10-52	ET UMBILICAL DOOR T/B FAILURE DUE TO OFF NOMINAL ET SEPARATION (ME)
SFOML-WING-11-1	ORBITER CAUSED INFLIGHT IMPACT
SFOML-WING-11-7	RSRM DEBRIS IMPACT ON ASCENT (ME)
SFOML-WING-11-11	SNEAK FLOW DUE TO TILE DAMAGE
SFOML-WING-11-13	SNEAK FLOW DUE TO STRUCTURAL DEFLECTION

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
SFOML-WING-11-14	FASTENER FAILURE DUE TO IMPROPER INSTALL
SFOML-WING-11-19	SNEAK FLOW DUE TO STRUCTURAL DEFLECTION
SFOML-WING-11-34	IMPACT
SFOML-WING-11-60	TPS IMPACTS ORBITER
SFOML-WING-11-61	ORBITER ACCESS PANEL
SFOML-WING-11-62	SSME INDUCED IMPACT INFLIGHT (ME)
SFOML-WING-11-64	SSME DEBRIS IMPACT (ASCENT)
SFOML-WING-11-65	SNEAK FLOW DUE TO MISSING / DISPLACED GAP FILLER
SFOML-WING-11-67	LOSS OF RCC PANEL DUE TO ANGEL-SEAL FAILURE
SFOML-WING-11-68	LOSS OF RCC PANEL DUE TO BUTTERFLY-SEAL FAILURE
SFOML-WING-12-1	ICICLE FORMS ON WASTE WATER OR SUPPLY WATER NOZZLE AND BREAKS OFF CAUSING INFLIGHT IMPACT
SFOML-WING-12-2	OTHER ORBITER CAUSED DEBRIS IMPACT
SFOML-WING-12-5	ICICLE FORMS ON WASTE WATER OR SUPPLY WATER NOZZLE AND BREAKS OFF ON ENTRY
SFOML-WING-12-6	OTHER ORBITER CAUSED DEBRIS IMPACT
SFOML-WING-12-10	RCC DAMAGE DUE TO OTHER EVENT
SFOML-WING-12-11	TILE DAMAGE DUE TO IMPACT
SFOML-WING-12-12	TILE DAMAGE DUE TO OTHER EVENT
SFOML-WING-12-13	SNEAK FLOW DUE TO SEAL DAMAGE INDUCED BY OTHER EVENT
SFOML-WING-12-19	ICE FORMED ON ORBITER SURFACE DUE TO SUPPLY/WASTE DUMP IMPINGEMENT
SFOML-WING-12-20	ET ATTACH CAUSES INFLIGHT IMPACT (ME)
SFOML-WING-12-21	ACCESS PANEL CAUSES INFLIGHT IMPACT
SFOML-WING-12-22	ICE FORMED ON ORBITER SURFACE DUE TO SUPPLY/WASTE DUMP IMPINGEMENT
SFOML-WING-12-23	LOST ACCESS PANEL IMPACTS ON ENTRY
SFOML-WING-12-24	FOD
SFOML-WING-12-90	Orbital Contact with External Tank (ME)
SFOML-WING-12-91	Orbiter Contact with SRB/RSRM (ME)
SFOML-WING-12-92	Contact with launch pad
SFOML-WING-12-93	SSME Debris impact (Entry)
SFSM	STRUCTURAL FAILURE OF ORBITER DUE TO LOSS OF STRUCTURAL MEMBER

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
SFSM-AFT	LOSS OF STRUCTURAL MEMBERS DUE TO AFT FUSELAGE FAILURE (ME)
SFSM-BAY	LOSS OF STRUCTURAL MEMBERS DUE TO PAYLOAD BAY DOOR FAILURE
SFSM-CABIN	LOSS OF STRUCTURAL MEMBERS DUE TO CREW CABIN MODULE FAILURE (ME)
SFSM-FLAP	LOSS OF STRUCTURAL MEMBERS DUE TO BODY FLAP FAILURE
SFSM-FRCS	LOSS OF STRUCTURAL MEMBERS DUE TO FRCS STRUCTURAL FAILURE
SFSM-FWD	LOSS OF STRUCTURAL MEMBERS DUE TO FWD FUSELAGE FAILURE
SFSM-MID	LOSS OF STRUCTURAL MEMBERS DUE TO MID-FUSELAGE FAILURE
SFSM-OMS	LOSS OF STRUCTURAL MEMBERS DUE TO ORBITAL MANEUVERING SYSTEM POD FAILURE
SFSM-PAY	LOSS OF STRUCTURAL MEMBER DUE TO FAILURE INTERNAL TO PAYLOAD BAY
SFSM-PAY-6-1	FAILURE INTERNAL TO PAYLOAD BAY DUE TO FAILURE OF CARGO INTEGRATED HARDWARE (ME)
SFSM-PAY-6-2	FAILURE INTERNAL TO PAYLOAD BAY DUE TO PAYLOAD HARDWARE (ME)
SFSM-PAY-6-3	FAILURE INTERNAL TO PAYLOAD BAY DUE TO ORBITER HARDWARE (ME)
SFSM-TAIL	LOSS OF STRUCTURAL MEMBERS DUE TO TAIL-RUDDER SPEED BREAK FAILURE
SFSM-WINDOW	LOSS OF STRUCTURAL MEMBERS DUE TO WINDOW FAILURE
SFSM-WING	LOSS OF STRUCTURAL MEMBERS DUE TO WING FAILURE

Section B

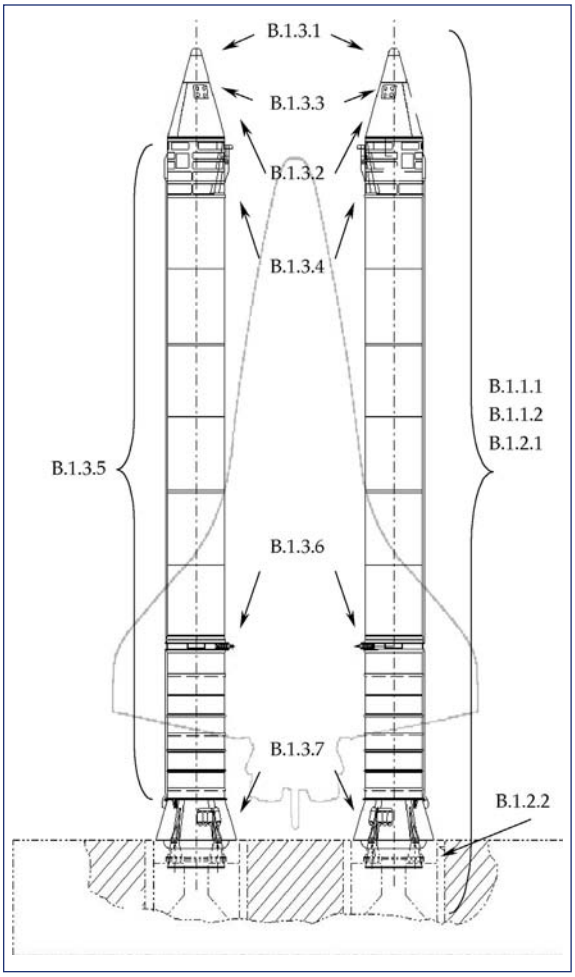
SSME: (Space Shuttle Main Engine)

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
SSME-E1.0	SSME Causes Structural Failure of Orbiter
SSME-E1.1	SSME Provides Constituent For Explosion/Combustion During Reentry

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
SSME-E1.1.1	SSME Hydraulic Leak Provides Fuel for Explosion/Combustion
SSME-E1.1.2	Residual Hydrogen or Oxygen Remain in the Engine (i.e. Propellant Dump Anomaly)
SSME-E1.1.3	SSME Electrical System Causes Ignition
SSME-E1.2	SSME Produces Debris Which Damages Orbiter Structure
SSME-E1.2.1	Debris Damages Aft Compartment
SSME-E1.2.2	Debris Damage Occurs External to Aft Compartment
SSME-E1.2.2.1	SSME Exhaust Causes Debris During Launch
SSME-E1.2.2.2	Off-Nominal SSME Operation Causes STS Debris
SSME-E1.2.2.3	SSME Causes Debris Damage on Orbit (i.e. Nozzle Debris Impact)
SSME-E1.3	SSME Imparts Off-Nominal Loads Which Cause Structural Failure of Orbiter
SSME-E1.3.1	Off-Nominal Thrust Vector
SSME-E1.3.2	Off-Nominal Vibrations
SSME-E1.3.3	Off-Nominal Thermal Loads
SSME-E1.3.4	Over-Pressurization of Aft Compartment Due to an SSME Fluid System Leak
SSME-E1.3.5	Off-Nominal Acoustics
SSME-E1.4	Engine Configuration Effects Result in Structural Failure of Orbiter
SSME-E2.0	SSME Causes Failure of Orbiter System
SSME-E2.1	SSME Causes Orbiter Hydraulic System Failure
SSME-E2.1.1	SSME Hydraulic System Leak Causes Failure of Orbiter Hydraulic System
SSME-E2.1.2	SSME Actuators or Hydraulic Line Source of Contamination to Orbiter Hydraulic System
SSME-E2.2	SSME Causes Orbiter Pneumatic System Failure (i.e. SSME Pneumatic System Leak Causes Failure of Orbiter Pneumatic System)
SSME-E2.3	SSME Electrical System Negatively Affects Orbiter Control Capability (e.g. GPCs)
SSME-E2.4	SSME Obstructs Orbiter Control Surfaces
SSME-E2.4.1	Nozzle Debris (TPS or Ablative) Obstructs Aerodynamic Control Surface(s)
SSME-E2.4.2	Nozzle Position Obstructs Movement of Body Flap
SSME-E2.5	SSME Causes Condition that Exceeds Capability of Orbiter Flight Control System
SSME-E2.5.1	Off-Nominal SSME position Disrupts Orbiter Aerodynamics
SSME-E2.5.2	Structural Failure of SSME Component – Orbiter Mass and or CG shift
SSME-E2.6	Block II Engine Configuration Affects Result in Failure of Orbiter System

SECTION C

SRB: (SOLID ROCKET BOOSTERS)



LEGEND

B.1.1.1 Extreme Environments Adversely Affect SRB or SRB/ET Interface
B.1.1.2 Anomalous Loads Adversely Affect SRB or SRB/ET Interfaces
B.1.2.1 Electrical & Instrumentation Subsystem
B.1.2.2 Thrust Vector Control Subsystem
B.1.3.1 Nose Cap Assembly Damage/Malfunction Causes Debris
B.1.3.2 Frustum Assembly Damage/Malfunction Causes Debris
B.1.3.3 Premature Parachute Operation Causes Debris
B.1.3.4 Forward Skirt Assembly Damage/Malfunction Causes Debris
B.1.3.5 Tunnel Cover / Floor Plate Assembly Damage/ Malfunction Causes Debris
B.1.3.6 ETA Ring/Aft Attach Strut Assembly Damage/ Malfunction Causes Debris
B.1.3.7 Aft Skirt Assembly Damage/Malfunction Causes Debris

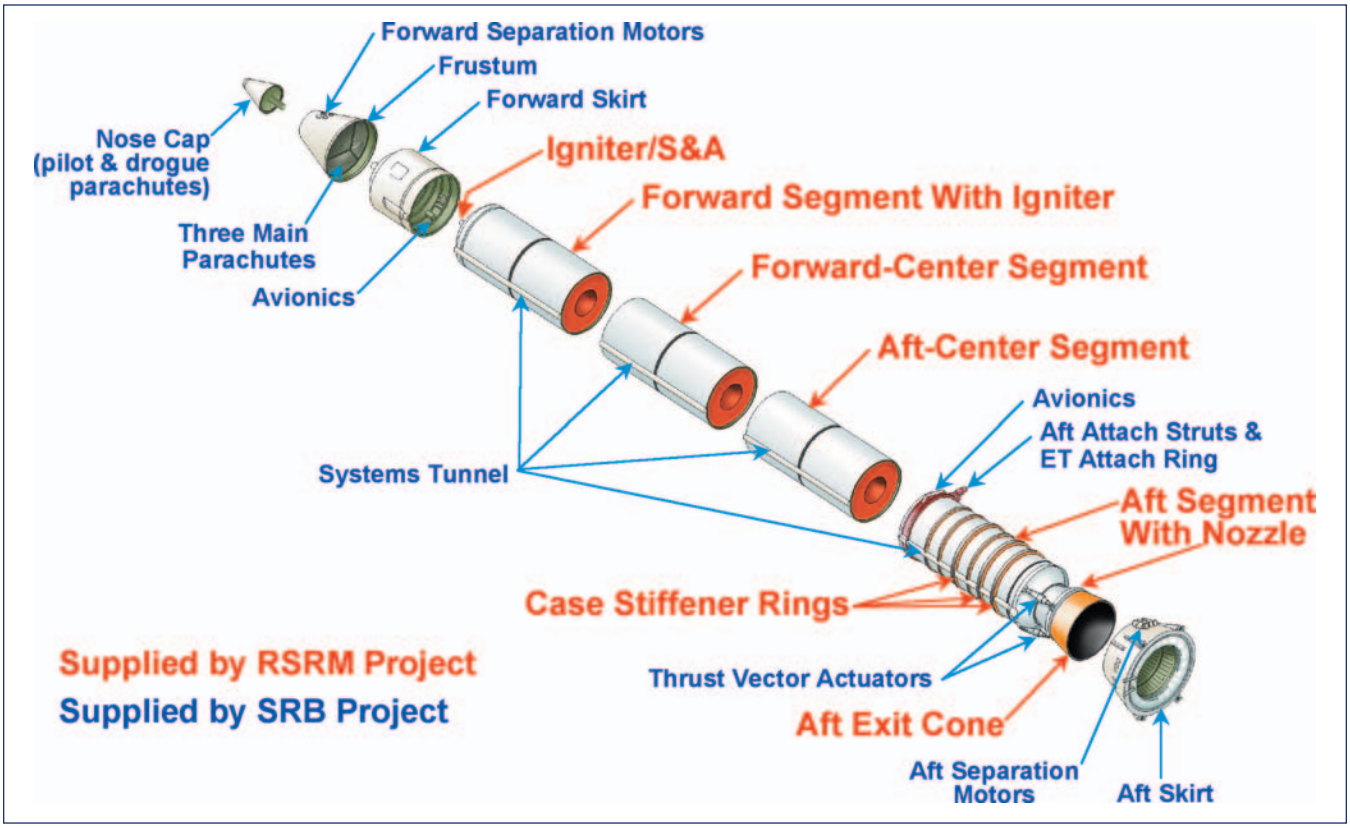
ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
B.1.1.1	Extreme Environments Adversely affect SRB or SRB/ET Interface
B.1.1.1.1	Extreme Natural Environments Adversely Affect SRB or SRB/ET Interface
B.1.1.1.2.A	Adverse Effects From Conducted or Radiated Electro Magnetic Interface (EMI)
B.1.1.1.2.B	Adverse Aerothermal Effects During Ascent
B.1.1.1.2.C	Adverse Vibro-Acoustic Effects While on Pad or During Ascent
B.1.1.1.2.D	Adverse Vehicle dynamics Effects While on Pad or During Ascent
B.1.1.1.2.E	Adverse Aerodynamic Effects During Ascent
B.1.1.1.2.F	Improper Venting During Ascent
B.1.1.1.2.G	Pyro Shock While on Pad or During Ascent
B.1.1.2	Anomalous Loads Adversely Affect SRB or SRB/ET Interfaces
B.1.1.2.A	Anomalous Loads Caused by Holddown Stud Hang-up
B.1.1.2.B	Anomalous Loads During Liftoff
B.1.1.2.1	Anomalous Loads During Prelaunch Operations

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
B.1.1.2.1.D	Adverse Loads Induced by SSME Thrust Build up
B.1.1.2.2	Anomalous Loads During Ascent
B.1.1.2.3	Anomalous Loads During Booster Separation
B.1.1.2.3.1.1.1	Premature Ignition (AFT BSM)
B.1.1.2.3.1.1.2	Low/Inadequate Thrust Output for any Two BSMs (AFT BSM)
B.1.1.2.3.1.2.1	Premature Ignition (Forward BSM)
B.1.1.2.3.1.2.2	Low/Inadequate Thrust Output for any Two BSMs (Forward BSM)
B.1.2.1	Anomalous Electrical and Instrumentations Subsystem Performance
B.1.2.2	Anomalous Thrust Vector Control (TVC) Subsystem Performance
B.1.3.2	Frustum Assembly Damage/Malfunction Causes Debris
B.1.3.2.A	Loss of Electrical Cables and Connect Components Causes Debris
B.1.3.2.B	Frustum Structural Failure Causes Debris
B.1.3.2.1	Loss of TPS Causes Debris
B.1.3.2.2	Loss of Frustum Components Causes Debris
B.1.3.2.4.A	Debris from Missing Cover Seal
B.1.3.2.4.3	Debris from Aeroheat Shield Structural Failure
B.1.3.2.4.4	Debris from Aeroheat Shield Failure to Achieve Minimum Opening Angle
B.1.3.2.5	Improper Operation of Pyrotechnic Components Causes Debris
B.1.3.3	Premature Parachute Operation Causes Debris
B.1.3.4	Forward Skirt Assembly Damage/Malfunction Causes Debris
B.1.3.4.A	Forward Skirt Structural Failure Causes Debris
B.1.3.4.B	Loss of Electrical Breakaway Cables and Connector Components (Sep. Plane) Causes Debris
B.1.3.4.1	Loss of TPS Causes Debris
B.1.3.4.1.1	Loss of Forward Separation Area ET Side TPS Causes Debris
B.1.3.4.2	Loss of Forward Skirt Components Causes Debris
B.1.3.4.2.C	Loss of Ordnance Ring Attach Pins and Retainer Clips Causes Debris
B.1.3.4.2.M	Loss of RSS Antennas Causes Debris
B.1.3.4.2.N	Loss of C-Band Antenna Causes Debris
B.1.3.4.3	Improper Operation of Pyrotechnic Components Causes Debris
B.1.3.4.4.1.A	Debris Due to No Separation
B.1.3.4.4.1.B	Debris Due to Premature Separation
B.1.3.4.4.1.1.A	Failure Outside of Fracture Plane Causes Debris
B.1.3.4.4.1.1.B	Recontact Causes Debris
B.1.3.4.4.1.1.1	Material Defects Causes Debris
B.1.3.4.4.1.1.2	Manufacturing Defect Causes Debris
B.1.3.4.4.2	Debris Generation from Range Safety System Crossover (ET side)
B.1.3.5	Tunnel Cover/Floor Plate Assembly Damage/Malfunction Causes Debris

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
B.1.3.5.A	Structural Damage to Tunnel Cover Assembly Causes Debris
B.1.3.5.B	Loss of Electrical Cables and Connector Components Causes Debris
B.1.3.5.C	Improper Operation of Pyrotechnic Components Causes Debris
B.1.3.5.1	Loss of Thermal Protection System (TPS) Causes Debris [Tunnel Cover/Floor Plate Assembly]
B.1.3.5.2	Loss of Tunnel over/Floor Plate Components Causes Debris (SRB/RSRM)
B.1.3.6	ETA Ring/Aft Attach Strut Assembly Damage/Malfunction Causes Debris
B.1.3.6.A	Loss of Electrical Breakaway Cables and Connector Components (Separation Plane)
B.1.3.6.B	External Tank Attach Ring Structural Failure
B.1.3.6.1	Loss of Thermal Protection System (TPS) Causes Debris
B.1.3.6.1.1	Loss of Aft Separation Area ET Side TPS Causes Debris
B.1.3.6.2	Aft Strut Component Failure (ET Strut Half)
B.1.3.6.3	Loss of ETA Ring Components/SRB Strut Half Causes Debris
B.1.3.6.3.G	Loss of Diagonal Strut Restraint Cable Causes Debris
B.1.3.6.4.A	No Separation Causes Debris
B.1.3.6.4.B	Premature Separation Causes Debris
B.1.3.6.4.1.A	Failure Outside Fracture Plane Causes Debris
B.1.3.6.4.1.B	Recontact of the Aft Separation Bolt Halves after Separation Causes Debris
B.1.3.6.4.1.1	Material Defects Causes Debris
B.1.3.6.4.1.2	Manufacturing Defect Causes Debris
B.1.3.6.5	Aft Attach Strut Pyrotechnics Causes Debris
B.1.3.7	Aft Skirt Assembly Damage/Malfunction Causes Debris
B.1.3.7.A	Loss of Electrical Breakaway Cables and Connector Components (Separation Plane)
B.1.3.7.B	Aft Skirt Assembly Structural Failure Causes Debris
B.1.3.7.1	Loss of TPS Causes Debris
B.1.3.7.1.1.A	Loss of Cork with Hypalon Causes Debris
B.1.3.7.1.1.B	Loss of BTA with Hypalon Causes Debris
B.1.3.7.2	Loss of Aft Skirt Components Causes Debris
B.1.3.7.2.B	Loss of Debris Containment Device Causes Debris
B.1.3.7.2.M	Loss of Blast Container Causes Debris
B.1.3.7.2.S	Loss of Thermal Curtains Causes Debris (Fabric)
B.1.3.7.3	Debris from Aft Booster Separation Motor Components
B.1.3.7.4.1	Improper Operation of SRB/MLP Holddown Release
B.1.3.7.4.2	Improper Operation of Booster Separation Motor Ignition Components
B.1.3.7.5	Debris from Thrust Vector Control (TVC)
B.1.3.7.6.A	Loss of Aft Skirt Shoe Hardware Causes Debris (includes shims and ground straps)
B.1.3.7.6.B	Loss of GN2 Purge Line Assembly Causes Debris
B.1.3.7.6.C	Loss of Holddown Hardware Causes Debris (includes stud washer, nut and breaklink nut)

SECTION D

RSRM: (REUSABLE SOLID ROCKET MOTOR)



ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
RSRM	Loss of Orbiter During Reentry Due to Anomalous RSRM Behavior
RSRM-M1.0	RSRM Generates Debris/FOD During Ascent
RSRM-M1.1	Thrown/Rebound Debris During Ignition/Lift-off Strikes Other Element
RSRM-M1.1.1	Nozzle Plug
RSRM-M1.1.2	Debris from Non-RSRM Source
RSRM-M1.1.3	RSRM Components
RSRM-M1.1.3.1	RSRM Internal Components
RSRM-M1.1.3.2	RSRM External Components
RSRM-M1.2	Systems Tunnel Floor Plate(s) Departs RSRM
RSRM-M1.3	Joint Protection System Departs RSRM
RSRM-M1.4	Anomalous Loss of Paint from RSRM
RSRM-M1.5	Instrumentation & Associated Hardware Departs RSRM
RSRM-M1.6	Stiffener Ring Insulation Departs RSRM
RSRM-M1.7	Stiffener Rings Depart RSRM
RSRM-M1.8	Ice Forms and Departs RSRM
RSRM-M1.9	Slice Plate Departs RSRM

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
RSRM-M1.10	Failure to Contain Motor Combustion Gases
RSRM-M2.0	RSRM Transfers Anomalous Loads Through Attach Points
RSRM-M2.1	Anomalous Structural Loads
RSRM-M2.1.1	Unsteady (>1 Hz) & Transient
RSRM-M2.1.1.1	RSRM Produces and Anomalous Initial Impulse
RSRM-M2.1.1.1.1	Anomalous Ignition
RSRM-M2.1.1.1.2	Anomalous but Balanced, Rises Rates
RSRM-M2.1.1.1.3	Unbalanced Rise Rates Between the RSRMs
RSRM-M2.1.1.2	RSRM Produces Anomalous Thrust Oscillations
RSRM-M2.1.1.3	Anomalous SRB Separation Due to RSRM
RSRM-M2.1.1.3.1	Anomalous Tail-off
RSRM-M2.1.1.3.2	Anomalous Separation Sequence Cueing Pressure Measurement/Transmission
RSRM-M2.1.1.4	RSRM Nozzle Deflection
RSRM-M2.1.2	Steady
RSRM-M2.1.2.1	RSRM Produces Anomalous, But Balanced Thrust
RSRM-M2.1.2.2	RSRM Produces Anomalous Unbalanced Thrust
RSRM-M2.1.2.3	RSRM Produces Anomalous Pressure Perturbations
RSRM-M2.1.2.4	RSRM Nozzle Deflection
RSRM-M2.2	Anomalous Thermal Loads
RSRM-M3.0	RSRM Generates Anomalous Induced Environments
RSRM-M3.1	Acoustic Anomalies
RSRM-M3.1.1	Excessive Ignition Acoustic Loading
RSRM-M3.1.2	Excessive In-Flight Acoustic Loading
RSRM-M3.2	Thermal Anomalies
RSRM-M3.2.1	RSRM Ignition/Plume Rebound
RSRM-M3.2.2	RSRM Excessive Plume Convective Recirculation
RSRM-M3.2.3	Failure to Contain Motor Combustion Gases

SECTION E

INTEGRATION

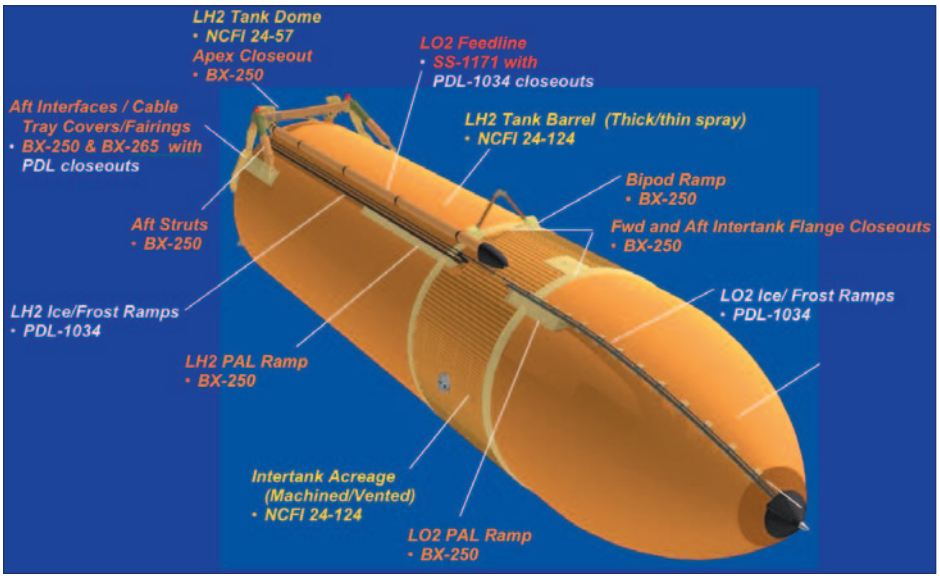
ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
B072	POGO Fault
B392	Thermal Environmental Fault/Out of Family
B396	Acoustic Fault/Out of Family
B397	Vibration Fault
G069	Integrated Vehicle Ascent Loads Fault/Out of Family

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
B523	ET Orbiter Umbilical Fire Causes Debris
B751	Airloads
B752	Aero/Plume Heating
B754	Vibration Fault/Out of Family
G386	Payload Induced Fires
B816	T-0 Umbilical Separation Anomaly
B817	Cargo Integration Hardware Induced Fires
B819	HDP Separation Anomaly
B820	GUCP/ET LH2 Vent Arm Separation Anomaly
G821	OLF/MDD Operation Load Fault/Out of Family
G824	OPF Operations Fault/Out of Family
B873	SRB Setdown Anomaly
B874	SRB Stacking Anomaly
B876	ET Mate Anomaly
B877	Orbiter Mate Anomaly
B878	Crawler Transporter Anomaly
B879	Payload Installation Anomaly
B880	ET Cryo Load Anomaly
B137	Ground Handling Non Integrated
G138	Crawler Transporter Loads Fault/Out of Family
G139	On Pad Loads Fault/Out of Family
G140	Integrated VAB Operations Loads Fault/Out of Family

SECTION F

ET: (EXTERNAL TANK)

Elements listed as "open due to lower element" refer to Fault Tree Elements contained in Appendix D.4.



ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
1.1.1.1 Open due to lower element	NCFI 24-124
1.1.1.1.1 Open due to lower element	LO2 Tank Acreage
1.1.1.1.1.1	Foam Application-LO2 Tank Ogive & Barrel
1.1.1.1.1.1.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.1.1.1.1.2 Open due to lower element	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.1.1.1.2.1	NCFI 24-124 Raw Material
1.1.1.1.1.1.2.2	Cleaning Raw Material
1.1.1.1.1.1.2.3	Primer Raw Material
1.1.1.1.1.1.2.4	Ducommun/MAF Material Processing
1.1.1.1.1.1.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.1.1.1.3.1	Debris Due to MAF Process Training
1.1.1.1.1.1.3.2	Debris Due to Manufacturing Process Plan
1.1.1.1.1.1.3.3	Debris Due to MAF NCFI 24-124 Material Processing
1.1.1.1.1.1.3.4	Debris Due to MAF Cleaning Material Processing
1.1.1.1.1.1.3.5	Debris Due to MAF Primer Material Processing
1.1.1.1.1.1.3.6	Debris Due to MAF Weld Processing
1.1.1.1.1.1.3.7	Debris Due to External Elements During MAF Processing
1.1.1.1.1.1.3.8	Debris Due to Incipient Weld Leak
1.1.1.2 Open due to lower element	Intertank Acreage
1.1.1.2.1 Open due to lower element	Foam Application-Intertank, Outside Surface
1.1.1.1.2.1.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.1.2.1.2 Open due to lower element	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.1.2.1.2.1	NCFI 24-124 Raw Material
1.1.1.1.2.1.2.2	DPTU Adhesive Raw Material
1.1.1.1.2.1.2.3	LearJet Cleaning Raw Material
1.1.1.1.2.1.2.4	LearJet Primer Raw Material
1.1.1.1.2.1.2.5	Debris Due to LearJet Manufacturing Process Plan
1.1.1.1.2.1.2.6	Debris Due to LearJet Cleaning Material Processing
1.1.1.1.2.1.2.7	Debris Due to LearJet Primer Material Processing

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
1.1.1.1.2.1.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.1.2.1.3.1	Debris Due to MAF Process Training
1.1.1.1.2.1.3.2	Debris Due to Manufacturing Process Plan
1.1.1.1.2.1.3.3	Debris Due to MAF NCFI 24-124 Material Processing
1.1.1.1.2.1.3.4	Debris Due to MAF DPTU Adhesive Material Processing
1.1.1.1.2.1.3.5	Debris Due to External Events During MAF Processing
1.1.1.1.2.1.3.6	Debris Due to Mechanical Assembly Anomaly
1.1.1.1.2.2 Open due to lower element	I/T Foam Machining, Cell "L", +Z Stringer Panels and Thrust Panels
1.1.1.1.2.2.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS (Ref. 1.1.1.1.2.1.1)
1.1.1.1.2.2.2 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.1.2.2.2.1	Debris Due to MAF Process Training
1.1.1.1.2.2.2.2	Debris Due to Manufacturing Process Plan
1.1.1.1.2.2.2.3	Debris Due to External Events During MAF Processing
1.1.1.1.2.2.2.4	Debris Due to Mechanical Assembly Anomaly
1.1.1.1.2.3 Open due to lower element	Intertank Foam Venting
1.1.1.1.2.3.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS (Ref. 1.1.1.1.2.1.1)
1.1.1.1.2.3.2 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.1.2.3.2.1	Debris Due to MAF Process Training
1.1.1.1.2.3.2.2	Debris Due to Manufacturing Process Plan
1.1.1.1.2.3.2.3	Debris Due to External Events During MAF Processing
1.1.1.1.2.3.2.4	Debris Due to Mechanical Assembly Anomaly
1.1.1.1.3 Open due to lower element	LH2 Tank Acreage
1.1.1.1.3.1 Open due to lower element	Foam Spray-LH2 Barrel
1.1.1.1.3.1.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.1.3.1.2 Open due to lower element	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.1.3.1.2.1	NCFI 24-124 Raw Material
1.1.1.1.3.1.2.2	Cleaning Raw Material
1.1.1.1.3.1.2.3	Primer Raw Material
1.1.1.1.3.1.2.4	Ducommun/Grumman/Reynolds Material Processing

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
1.1.1.1.3.1.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.1.3.1.3.1	Debris Due to MAF Process Training
1.1.1.1.3.1.3.2	Debris Due to Manufacturing Process Plan
1.1.1.1.3.1.3.3	Debris Due to MAF NCFI 24-124 Material Processing
1.1.1.1.3.1.3.4	Debris Due to MAF Cleaning Material Processing
1.1.1.1.3.1.3.5	Debris Due to MAF Primer Material Processing
1.1.1.1.3.1.3.6	Debris Due to MAF Weld Processing
1.1.1.1.3.1.3.7	Debris Due to External Events During MAF Processing
1.1.1.1.3.1.3.8	Debris Due to Incipient Weld Leak
1.1.1.2	NCFI 24-57
1.1.1.3 Open due to lower element	PDL-1034
1.1.1.3.1 Open due to lower element	Bipod
1.1.1.3.2 Open due to lower element	LH2 & I/T Splice
1.1.1.3.3 Open due to lower element	LO2 & I/T Splice, P/L Bracket 861, & Aero Vents
1.1.1.3.3.1 Open due to lower element	LO2 Tank to I/T Splice, P/L Bracket Sta. 861 Aero Vents
1.1.1.3.3.1.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.3.3.1.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.3.3.1.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.3.3.1.3.1	Debris Due to MAF Process Training
1.1.1.3.3.1.3.2	Debris Due to Manufacturing Process Plan
1.1.1.3.3.1.3.4	Debris Due to MAF DPTU Adhesive Material Processing
1.1.1.3.3.1.3.5	Debris Due to External Events During MAF Processing
1.1.1.3.3.1.3.6	Debris Due to Mechanical Assembly Anomaly
1.1.1.3.4 Open due to lower element	LO2 P/L & C/T Brackets
1.1.1.3.4.1 Open due to lower element	TPS Application-LO2 Tank Ice Frost Ramps-Cell "G" & "H"
1.1.1.3.4.1.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.3.4.1.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.3.4.1.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.3.4.1.3.1	Debris Due to MAF Process Training

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
1.1.1.3.4.1.3.2	Debris Due to Manufacturing Process Plan
1.1.1.3.4.1.3.4	Debris Due to MAF DPTU Adhesive Material Processing
1.1.1.3.4.1.3.5	Debris Due to External Events During MAF Processing
1.1.1.3.4.1.3.6	Debris Due to Mechanical Assembly Anomaly
1.1.1.3.4.2 Open due to lower element	TPS Closeout-ET Complete, Bldg 420 (Xt371 CO)
1.1.1.3.6 Open due to lower element	I/T Wedges
1.1.1.3.6.1 Open due to lower element	Foam Wedge Application- I/T Position #3
1.1.1.3.6.1.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.3.6.1.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.3.6.1.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.3.6.1.3.1	Debris Due to MAF Process Training
1.1.1.3.6.1.3.2	Debris Due to Manufacturing Process Plan
1.1.1.3.6.1.3.4	Debris Due to External Events During MAF Processing
1.1.1.3.6.1.3.5	Debris Due to Mechanical Assembly Anomaly
1.1.1.3.7 Open due to lower element	I/T P/L & C/T Brackets & Fairings
1.1.1.3.7.1 Open due to lower element	Support Bracket-GO2 P/L & C/T, I/T, Foam Application
1.1.1.3.7.1.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.3.7.1.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.3.7.1.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.3.7.1.3.1	Debris Due to MAF Process Training
1.1.1.3.7.1.3.2	Debris Due to Manufacturing Process Plan
1.1.1.3.7.1.3.4	Debris Due to MAF DPTU Adhesive Material Processing
1.1.1.3.7.1.3.5	Debris Due to External Events During MAF Processing
1.1.1.3.7.1.3.6	Debris Due to Mechanical Assembly Anomaly
1.1.1.3.7.2 Open due to lower element	Foam CO- I/T Fairings, RSS Antennas & Xt 1082.8 P/L & C/T Support
1.1.1.3.7.2.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.3.7.2.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.3.7.2.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.3.7.2.3.1	Debris Due to MAF Process Training

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
1.1.1.3.7.2.3.2	Debris Due to Manufacturing Process Plan
1.1.1.3.7.2.3.4	Debris Due to MAF DPTU Adhesive Material Processing
1.1.1.3.7.2.3.5	Debris Due to External Events During MAF Processing
1.1.1.3.7.2.3.6	Debris Due to Mechanical Assembly Anomaly
1.1.1.3.7.3 Open due to lower element	Foam Closeout-Intertank Press Line & Cable Tray Support Brackets
1.1.1.3.7.3.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.3.7.3.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.3.7.3.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.3.7.3.3.1	Debris Due to MAF Process Training
1.1.1.3.7.3.3.2	Debris Due to Manufacturing Process Plan
1.1.1.3.7.3.3.4	Debris Due to MAF DPTU Adhesive Material Processing
1.1.1.3.7.3.3.5	Debris Due to External Events During MAF Processing
1.1.1.3.7.3.3.6	Debris Due to Mechanical Assembly Anomaly
1.1.1.3.8 Open due to lower element	LO2 Feed Line & Supports (External)
1.1.1.3.8.1 Open due to lower element	TPS Closeout-Final Assy Feedline Yokes & Base Fittings
1.1.1.3.8.1.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.3.8.1.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.3.8.1.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.3.8.1.3.1	Debris Due to MAF Process Training
1.1.1.3.8.1.3.2	Debris Due to Manufacturing Process Plan
1.1.1.3.8.1.3.4	Debris Due to MAF DPTU Adhesive Material Processing
1.1.1.3.8.1.3.5	Debris Due to External Events During MAF Processing
1.1.1.3.8.1.3.6	Debris Due to Mechanical Assembly Anomaly
1.1.1.3.8.2 Open due to lower element	CO-LO2 F/L Flanges & Elbow Tie, Xt1115-2053 & LH2 F/L Base CO
1.1.1.3.8.2.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.3.8.2.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.3.8.2.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.3.8.2.3.1	Debris Due to MAF Process Training
1.1.1.3.8.2.3.2	Debris Due to Manufacturing Process Plan

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
1.1.1.3.8.2.3.4	Debris Due to MAF DPTU Adhesive Material Processing
1.1.1.3.8.2.3.5	Debris Due to External Events During MAF Processing
1.1.1.3.8.2.3.6	Debris Due to Mechanical Assembly Anomaly
1.1.1.3.8.3 Open due to lower element	Feedline-LO2 Aluminum Straight Section Foam Application
1.1.1.3.8.3.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.3.8.3.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.3.8.3.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.3.8.3.3.1	Debris Due to MAF Process Training
1.1.1.3.8.3.3.4	Debris Due to External Events During MAF Processing
1.1.1.3.8.3.3.5	Debris Due to Mechanical Assembly Anomaly
	Strut, LO2 Feedline, Foam Application
1.1.1.3.8.4.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS (Ref. 1.1.1.3.8.1.1)
1.1.1.3.8.4.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.3.8.4.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.3.8.4.3.1	Debris Due to MAF Process Training
1.1.1.3.8.4.3.2	Debris Due to Manufacturing Process Plan
1.1.1.3.8.4.3.4	Debris Due to External Events During MAF Processing
1.1.1.3.8.4.3.5	Debris Due to Mechanical Assembly Anomaly
1.1.1.3.8.5	Foam CO-Final Assembly, LO2 & LH2 F/L Inboard Support To Xbeam
1.1.1.3.8.6	Foam Closeout-Cell "C", LO2 Feedline Support Sta 1623.8, 1871.0, And 1973.5, LH2 Tank
1.1.1.3.9 Open due to lower element	LO2 PAL Ramp
1.1.1.3.10	Vent Lines
1.1.1.3.11	Aft Feed Line & Supports (External)
1.1.1.3.12	LH2 PAL Ramp
1.1.1.3.13	LH2 P/L & C/T Brackets & Fairings
1.1.1.3.14	LH2 Barrel
1.1.1.3.15	Aft I/F Hardware & Closeouts
1.1.1.3.16	Aft Fairings
1.1.1.3.17	SRB PAL Ramps

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
1.1.1.3.18	LH2 Aft Dome
1.1.1.3.19	KSC TPS 3rd Hardpoint
1.1.1.3.20	Nose Cone Closeout (Internal)
1.1.1.3.21	TPS Closeout-ET Complete, Bldg 420 (I/T CO GH2 VV Sensor Port)
1.1.1.4 Open due to lower element	BX-250
1.1.1.4.1 Open due to lower element	Bipod
1.1.1.4.1.1 Open due to lower element	TPS Closeout-Final Assembly, Forward Bipod Fittings
1.1.1.4.1.1.1 Open due to lower element	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.4.1.1.1.2	Inadequate Design Implementation
1.1.1.4.1.1.1.3	Inadequate Design Requirements (Loads & Environments)
1.1.1.4.1.1.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.4.1.1.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.4.1.1.3.1 Open due to lower element	Debris Due to MAF Process Training
1.1.1.4.1.1.3.1.2	Uncertified Operator
1.1.1.4.1.1.3.2 Open due to lower element	Debris Due to Manufacturing Process Plan
1.1.1.4.1.1.3.3	Debris Due to Operator Not Following Manufacturing Process Plan
1.1.1.4.1.1.3.3 Open due to lower element	Debris Due to MAF BX-250 Material Processing
1.1.1.4.1.1.3.3.1	Shelf Life Issue
1.1.1.4.1.1.3.3.3	Contamination During Processing
1.1.1.4.1.1.3.3.4	Improper Surface Preparation
1.1.1.4.1.1.3.3.7	Improperly Performed Acceptance Testing
1.1.1.4.1.1.3.3.8	Inadequate Resolution of Identified Anomaly
1.1.1.4.1.1.3.4	Debris Due to MAF DPTU Adhesive Material
1.1.1.4.1.1.3.5	Debris Due to External Events During MAF Processing
1.1.1.4.1.1.3.6	Debris Due to Mechanical Assembly Anomaly
1.1.1.4.2 Open due to lower element	LH2 & I/T Splice
1.1.1.4.2.1 Open due to lower element	TPS CO-I/T To LH2 Tank, Cell "A" Stack & LH2 Aft Dome Apex
1.1.1.4.2.1.1 Open due to lower element	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.4.2.1.1.2	Inadequate Design Implementation

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
1.1.1.4.2.1.1.3	Inadequate Design Requirements (Loads & Environments)
1.1.1.4.2.1.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.4.2.1.2.1	BX-250 Raw Material
1.1.1.4.2.1.2.2	DPTU Adhesive Raw Material
1.1.1.4.2.1.2.3	26L26 Bolt
1.1.1.4.2.1.2.4	21L1 Washer
1.1.1.4.2.1.2.5	33L19 Nut
1.1.1.4.2.1.2.6	Undetected Anomaly
1.1.1.4.2.1.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.4.2.1.3.1 Open due to lower element	Debris Due to MAF Process Training
1.1.1.4.2.1.3.1.2	Uncertified Operator
1.1.1.4.2.1.3.2	Debris Due to Manufacturing Process Plan
1.1.1.4.2.1.3.2.1	Debris Due to Inadequate Manufacturing Process Plan
1.1.1.4.2.1.3.2.2	Debris Due to Operator Not Following Manufacturing Process Plan
1.1.1.4.2.1.3.3 Open due to lower element	Debris Due to MAF BX-250 Material Processing
1.1.1.4.2.1.3.3.1	Shelf Life Issue
1.1.1.4.2.1.3.3.3	Contamination During Processing
1.1.1.4.2.1.3.3.4	Improper Surface Preparation
1.1.1.4.2.1.3.3.	Improperly Performed Acceptance Testing
1.1.1.4.2.1.3.3.8	Inadequate Resolution of Identified Anomaly
1.1.1.4.2.1.3.4	Debris Due to MAF DPTU Adhesive Material Processing
1.1.1.4.2.1.3.4.1	Shelf Life Issue
1.1.1.4.2.1.3.4.2	Improper Storage
1.1.1.4.2.1.3.4.3	Contamination During Processing
1.1.1.4.2.1.3.4.4	Improper Surface Preparation
1.1.1.4.2.1.3.4.5	Improper Application Process
1.1.1.4.2.1.3.4.6	Inadequately Defined Acceptance Testing
1.1.1.4.2.1.3.4.7	Improperly Performed Acceptance Testing
1.1.1.4.2.1.3.4.8	Inadequate Resolution of Identified Anomaly

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
1.1.1.4.2.1.3.5	Debris Due to MAF Bolt Installation Processing
1.1.1.4.2.1.3.6	Debris Due to External Events During MAF Processing
1.1.1.4.2.1.3.7	Debris Due to Mechanical Assembly Anomaly
1.1.1.4.3 Open due to lower element	LO2 & IT Splice, P/L Brkt 861, & Aero Vents
1.1.1.4.3.1 Open due to lower element	Foam appl.-LO2 Tank to I/T Splice, P/L Brkt Sta. 861 aero Vents
1.1.1.4.3.1.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.4.3.1.1.1	Inadequate Design Methodology
1.1.1.4.3.1.1.2	Inadequate Design Implementation
1.1.1.4.3.1.1.2.1	Incorrect Materials Identified
1.1.1.4.3.1.1.2.2	Incorrect Processes Identified
1.1.1.4.3.1.1.2.3	Incorrect Configuration/Dimensions Identified
1.1.1.4.3.1.1.2.4	Incorrect ET Effectivity Identified
1.1.1.4.3.1.1.3	Inadequate Design Requirements (Loads & Environments)
1.1.1.4.3.1.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.4.3.1.2.1	BX-250 Raw Material
1.1.1.4.3.1.2.1.1	Incorrect Material
1.1.1.4.3.1.2.1.2	Shelf Life Issue
1.1.1.4.3.1.2.1.3	Improper Storage
1.1.1.4.3.1.2.1.4	Contamination During Processing
1.1.1.4.3.1.2.1.5	Improper Shipping
1.1.1.4.3.1.2.1.6	Inadequate Resolution of Identified Anomaly
1.1.1.4.3.1.2.2	DPTU Adhesive Raw Material
1.1.1.4.3.1.2.3	26L26 Bolt
1.1.1.4.3.1.2.4	21L1 Washer
1.1.1.4.3.1.2.5	33L19 Nut
1.1.1.4.3.1.2.6	Undetected Anomaly
1.1.1.4.3.1.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.4.3.1.3.1 Open due to lower element	Debris Due to MAF Process Training
1.1.1.4.3.1.3.1.2	Uncertified Operator

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
1.1.1.4.3.1.3.2	Debris Due to Manufacturing Process Plan
1.1.1.4.3.1.3.2.1	Debris Due to Inadequate Manufacturing Process Plan
1.1.1.4.3.1.3.2.2	Debris Due to Operator Not Following Manufacturing Process Plan
1.1.1.4.3.1.3.3 Open due to lower element	Debris Due to MAF BX-250 Material Processing
1.1.1.4.3.1.3.3.1	Shelf Life Issue
1.1.1.4.3.1.3.3.3	Contamination During Processing
1.1.1.4.3.1.3.3.4	Improper Surface Preparation
1.1.1.4.3.1.3.3.6	Inadequately Defined Acceptance Testing
1.1.1.4.3.1.3.3.7	Improperly Performed Acceptance Testing
1.1.1.4.3.1.3.3.8	Inadequate Resolution of Identified Anomaly
1.1.1.4.3.1.3.4	Debris Due to MAF DPTU Adhesive Material Processing
1.1.1.4.3.1.3.4.1	Shelf Life Issue
1.1.1.4.3.1.3.4.2	Improper Storage
1.1.1.4.3.1.3.4.3	Contamination During Processing
1.1.1.4.3.1.3.4.4	Improper Surface Preparation
1.1.1.4.3.1.3.4.5	Improper Application Process
1.1.1.4.3.1.3.4.6	Inadequately Defined Acceptance Testing
1.1.1.4.3.1.3.4.7	Improperly Performed Acceptance Testing
1.1.1.4.3.1.3.4.8	Inadequate Resolution of Identified Anomaly
1.1.1.4.3.1.3.5	Debris Due to MAF Bolt Installation Processing (80911100000)
1.1.1.4.3.1.3.6	Debris Due to External Events During MAF Processing
1.1.1.4.3.1.3.7	Debris Due to Mechanical Assembly Anomaly
1.1.1.4.4 Open due to lower element	I/T Wedges
1.1.1.4.4.1 Open due to lower element	Foam Wedge Appl- I/T Position #3
1.1.1.4.4.1.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.4.4.1.1.1	Inadequate Design Methodology
1.1.1.4.4.1.1.2	Inadequate Design Implementation
1.1.1.4.4.1.1.2.1	Incorrect Materials Identified
1.1.1.4.4.1.1.2.2	Incorrect Processes Identified

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
1.1.1.4.4.1.1.2.3	Incorrect Configuration/Dimensions Identified
1.1.1.4.4.1.1.2.4	Incorrect ET Effectivity Identified
1.1.1.4.4.1.1.3	Inadequate Design Requirements (Loads & Environments)
1.1.1.4.4.1.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.4.4.1.2.1	BX-250 Raw Material
1.1.1.4.4.1.2.1.1	Incorrect Material
1.1.1.4.4.1.2.1.2	Shelf Life Issue
1.1.1.4.4.1.2.1.3	Improper Storage
1.1.1.4.4.1.2.1.4	Contamination During Processing
1.1.1.4.4.1.2.1.5	Improper Shipping
1.1.1.4.4.1.2.1.6	Inadequate Resolution of Identified Anomaly
1.1.1.4.4.1.2.2	Undetected Anomaly
1.1.1.4.4.1.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.4.4.1.3.1	Debris Due to MAF Process Training
1.1.1.4.4.1.3.1.1	Inadequately Trained Operator
1.1.1.4.4.1.3.1.2	Uncertified Operator
1.1.1.4.4.1.3.2	Debris Due to Manufacturing Process Plan
1.1.1.4.4.1.3.2.1	Debris Due to Inadequate Manufacturing Process Plan
1.1.1.4.4.1.3.2.2	Debris Due to Operator Not Following Manufacturing Process Plan
1.1.1.4.4.1.3.3 Open due to lower element	Debris Due to MAF BX-250 Material Processing
1.1.1.4.4.1.3.3.1	Shelf Life Issue
1.1.1.4.4.1.3.3.3	Contamination During Processing
1.1.1.4.4.1.3.3.4	Improper Surface Preparation
1.1.1.4.4.1.3.3.6	Inadequately Defined Acceptance Testing
1.1.1.4.4.1.3.3.7	Improperly Performed Acceptance Testing
1.1.1.4.4.1.3.3.8	Inadequate Resolution of Identified Anomaly
1.1.1.4.4.1.3.4	Debris Due to External Events During MAF Processing
1.1.1.4.4.1.3.5	Debris Due to Mechanical Assembly Anomaly
1.1.1.4.5 Open due to lower element	LO2 Feed Line Supports (External)

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
1.1.1.4.5.1 Open due to lower element	TPS Closeout-Final Assy Feedline Yokes & Base Fittings
1.1.1.4.5.1.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.4.5.1.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.4.5.1.2.1	BX-250 Raw Material
1.1.1.4.5.1.2.1.1	Incorrect Material
1.1.1.4.5.1.2.1.2	Shelf Life Issue
1.1.1.4.5.1.2.1.3	Improper Storage
1.1.1.4.5.1.2.1.4	Contamination During Processing
1.1.1.4.5.1.2.1.5	Improper Shipping
1.1.1.4.5.1.2.1.6	Inadequate Resolution of Identified Anomaly
1.1.1.4.5.1.2.2	DPTU Adhesive Raw Material
1.1.1.4.5.1.2.3	Undetected Anomaly
1.1.1.4.5.1.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.4.5.1.3.1	Debris Due to MAF Process Training
1.1.1.4.5.1.3.1.1	Inadequately Trained Operator
1.1.1.4.5.1.3.1.2	Uncertified Operator
1.1.1.4.5.1.3.2	Debris Due to Manufacturing Process Plan
1.1.1.4.5.1.3.2.1	Debris Due to Inadequate Manufacturing Process Plan
1.1.1.4.5.1.3.2.2	Debris Due to Operator Not Following Manufacturing Process Plan
1.1.1.4.5.1.3.3 Open due to lower element	Debris Due to MAF BX-250 Material Processing
1.1.1.4.5.1.3.3.1	Shelf Life Issue
1.1.1.4.5.1.3.3.3	Contamination During Processing
1.1.1.4.5.1.3.3.4	Improper Surface Preparation
1.1.1.4.5.1.3.3.6	Inadequately Defined Acceptance Testing
1.1.1.4.5.1.3.3.7	Improperly Performed Acceptance Testing
1.1.1.4.5.1.3.3.8	Inadequate Resolution of Identified Anomaly
1.1.1.4.5.1.3.4	Debris Due to MAF DPTU Adhesive Material Processing
1.1.1.4.5.1.3.4.1	Shelf Life Issue
1.1.1.4.5.1.3.4.2	Improper Storage

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
1.1.1.4.5.1.3.4.3	Contamination During Processing
1.1.1.4.5.1.3.4.4	Improper Surface Preparation
1.1.1.4.5.1.3.4.6	Inadequately Defined Acceptance Testing
1.1.1.4.5.1.3.4.7	Improperly Performed Acceptance Testing
1.1.1.4.5.1.3.4.8	Inadequate Resolution of Identified Anomaly
1.1.1.4.5.1.3.5	Debris Due to External Events During MAF Processing
1.1.1.4.5.1.3.6	Debris Due to Mechanical Assembly Anomaly
1.1.1.4.5.2	CO-LO2 F/L Flanges & Elbow Tie, Xt 1115-2053 & LH2 F/L Base CO
1.1.1.4.5.3	Foam CO-Cell "C", LO2 F/L Support Xt 1623.8, 1871.0, and 1973.5, LH2 Tank
1.1.1.4.6 Open due to lower element	LO2 PAL Ramp
1.1.1.4.6.1 Open due to lower element	Foam Application-LO2 Tank/Intertank Pal Ramp
1.1.1.4.6.1.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.4.6.1.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.4.6.1.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.4.6.1.3.1 Open due to lower element	Debris Due to MAF Process Training
1.1.1.4.6.1.3.1.2	Uncertified Operator
1.1.1.4.6.1.3.2	Debris Due to Manufacturing Process Plan
1.1.1.4.6.1.3.2.1	Debris Due to Inadequate Manufacturing Process Plan
1.1.1.4.6.1.3.2.2	Debris Due to Operator Not Following Manufacturing Process Plan
1.1.1.4.6.1.3.3 Open due to lower element	Debris Due to MAF BX-250 Material Processing
1.1.1.4.6.1.3.3.1	Shelf Life Issue
1.1.1.4.6.1.3.3.3	Contamination During Processing
1.1.1.4.6.1.3.3.4	Improper Surface Preparation
1.1.1.4.6.1.3.3.7	Improperly Performed Acceptance Testing
1.1.1.4.6.1.3.3.8	Inadequate Resolution of Identified Anomaly
1.1.1.4.6.1.3.4	Debris Due to MAF DPTU Adhesive Material Processing
1.1.1.4.6.1.3.4.1	Shelf Life Issue
1.1.1.4.6.1.3.4.2	Improper Storage
1.1.1.4.6.1.3.4.3	Contamination During Processing

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
1.1.1.4.6.1.3.4.4	Improper Surface Preparation
1.1.1.4.6.1.3.4.5	Improper Application Process
1.1.1.4.6.1.3.4.6	Inadequately Defined Acceptance Testing
1.1.1.4.6.1.3.4.7	Improperly Performed Acceptance Testing
1.1.1.4.6.1.3.4.8	Inadequate Resolution of Identified Anomaly
1.1.1.4.6.1.3.5	Debris Due to External Events During MAF Processing
1.1.1.4.6.1.3.6	Debris Due to Mechanical Assembly Anomaly
1.1.1.4.7	LO2 Dome
1.1.1.4.8	GO2 Vent Lines
1.1.1.4.9	LH2 PAL Ramp
1.1.1.4.10	Aft Feed Line Supports (External)
1.1.1.4.11	Aft I/F Hardware Closeouts
1.1.1.4.12	LH2 Aft Dome
1.1.1.4.13	LH2 Fwd Dome
1.1.1.4.14	LH2 C/T Fairing & Fwd PAL Ramp
1.1.1.4.15	Aft C/Ts
1.1.1.4.16	SRB PAL Ramps
1.1.1.4.17	KSC TPS 3rd Hardpoint
1.1.1.5 Open due to lower element	SLA-561
1.1.1.5.1 Open due to lower element	Bipod
1.1.1.5.1.1 Open due to lower element	TPS Closeout-Final Assembly, Forward Bipod Fittings
1.1.1.5.1.1.1 Open due to lower element	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.1.1.1.2	Inadequate Design Implementation
1.1.1.5.1.1.1.3	Inadequate Design Requirements (Loads & Environments)
1.1.1.5.1.1.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.1.1.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.1.1.3.1	Debris Due to MAF Process Training
1.1.1.5.1.1.3.2	Debris Due to Manufacturing Process Plan
1.1.1.5.1.1.3.3	Debris Due to Manufacturing Process Plan – Materials

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
1.1.1.5.1.1.3.4	Debris Due to Manufacturing Process Plan - Acceptance
1.1.1.5.1.1.3.5	Debris Due to External Events During MAF Processing
1.1.1.5.1.1.3.6	Debris Due to Mechanical Assembly Anomaly
1.1.1.5.1.2 Open due to lower element	Plate Connector-Bipod Fitting, SLA Application
1.1.1.5.1.2.1 Open due to lower element	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.1.2.1.2	Inadequate Design Implementation
1.1.1.5.1.2.1.3	Inadequate Design Requirements (Loads & Environments)
1.1.1.5.1.2.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.1.2.2.3	Undetected Anomaly
1.1.1.5.1.2.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.1.2.3.1	Debris Due to MAF Process Training
1.1.1.5.1.2.3.2	Debris Due to Manufacturing Process Plan
1.1.1.5.1.2.3.3	Debris Due to Manufacturing Process Plan – Materials
1.1.1.5.12.3.4	Debris Due to Manufacturing Process Plan - Acceptance
1.1.1.5.1.2.3.5	Debris Due to External Events During MAF Processing
1.1.1.5.1.2.3.6	Debris Due to Mechanical Assembly Anomaly
1.1.1.5.1.3 Open due to lower element	Bipod Struts, TPS Application
1.1.1.5.1.3.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.1.3.1.1	Inadequate Design Methodology
1.1.1.5.1.3.1.2	Inadequate Design Implementation
1.1.1.5.1.3.1.2.1	Incorrect Materials Identified
1.1.1.5.1.3.1.2.2	Incorrect Processes Identified
1.1.1.5.1.3.1.2.3	Incorrect Configuration/Dimensions Identified
1.1.1.5.1.3.1.2.4	Incorrect ET Effectivity Identified
1.1.1.5.1.3.1.3	Inadequate Design Requirements (Loads & Environments)
1.1.1.5.1.3.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.1.3.2.3	Undetected Anomaly
1.1.1.5.1.3.3	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.1.3.3.1	Debris Due to MAF Process Training

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
1.1.1.5.1.3.3.2	Debris Due to Manufacturing Process Plan
1.1.1.5.1.3.3.3	Debris Due to Manufacturing Process Plan - Material
1.1.1.5.1.3.3.4	Debris Due to Manufacturing Process Plan - Acceptance
1.1.1.5.1.3.3.5	Debris Due to External Events During MAF Processing
1.1.1.5.1.3.3.6	Debris Due to Mechanical Assembly Anomaly
1.1.1.5.2 Open due to lower element	LO2 C/Ts & Fairings
1.1.1.5.2.1 Open due to lower element	CO GO2 P/L Barry Mounts on LO2 Tank, Sta.371.0 C/T Brkt, & Foam Trims for GO2 P/L Flange
1.1.1.5.2.1.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.2.1.1.1	Inadequate Design Methodology
1.1.1.5.2.1.1.2	Inadequate Design Implementation
1.1.1.5.2.1.1.2.1	Incorrect Materials Identified
1.1.1.5.2.1.1.2.2	Incorrect Processes Identified
1.1.1.5.2.1.1.2.3	Incorrect Configuration/Dimensions Identified
1.1.1.5.2.1.1.2.4	Incorrect ET Effectivity Identified
1.1.1.5.2.1.1.3	Inadequate Design Requirements (Loads & Environments)
1.1.1.5.2.1.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.2.1.2.3	Undetected Anomaly
1.1.1.5.2.1.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.2.1.3.1	Debris Due to MAF Process Training
1.1.1.5.2.1.3.2	Debris Due to Manufacturing Process Plan
1.1.1.5.2.1.3.3	Debris Due to Manufacturing Process Plan - Material
1.1.1.5.2.1.3.4	Debris Due to Manufacturing Process Plan - Acceptance
1.1.1.5.2.1.3.5	Debris Due to External Events During MAF Processing
1.1.1.5.2.1.3.6	Debris Due to Mechanical Assembly Anomaly
1.1.1.5.2.2 Open due to lower element	SLA CO-Cell "M", LO2 P/L Brackets Sta. 404.34 thru Sta 718.04
1.1.1.5.2.2.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.2.2.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.2.2.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.2.2.3.1	Debris Due to MAF Process Training

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
1.1.1.5.2.2.3.2	Debris Due to Manufacturing Process Plan
1.1.1.5.2.2.3.3	Debris Due to Manufacturing Process Plan - Material
1.1.1.5.2.2.3.4	Debris Due to Manufacturing Process Plan - Acceptance
1.1.1.5.2.2.3.5	Debris Due to External Events During MAF Processing
1.1.1.5.2.2.3.6	Debris Due to Mechanical Assembly Anomaly
1.1.1.5.2.3 Open due to lower element	LO2 Tank Cable Tray Segment, SLA Application
1.1.1.5.2.3.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.2.3.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.2.3.2.3	Undetected Anomaly
1.1.1.5.2.3.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.2.3.3.1	Debris Due to MAF Process Training
1.1.1.5.2.3.3.2	Debris Due to Manufacturing Process Plan
1.1.1.5.2.3.3.3	Debris Due to Manufacturing Process Plan - Material
1.1.1.5.2.3.3.4	Debris Due to Manufacturing Process Plan - Acceptance
1.1.1.5.2.3.3.5	Debris Due to External Events During MAF Processing
1.1.1.5.2.3.3.6	Debris Due to Mechanical Assembly Anomaly
1.1.1.5.2.4 Open due to lower element	LO2 Tank P/L & C/T Support Sta. 371.0, SLA Application
1.1.1.5.2.4.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.2.4.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.2.4.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.2.4.3.1	Debris Due to MAF Process Training
1.1.1.5.2.4.3.2	Debris Due to Manufacturing Process Plan
1.1.1.5.2.4.3.3	Debris Due to Manufacturing Process Plan - Material
1.1.1.5.2.4.3.4	Debris Due to Manufacturing Process Plan – Acceptance
1.1.1.5.2.4.3.5	Debris Due to External Events During MAF Processing
1.1.1.5.2.4.3.6	Debris Due to Mechanical Assembly Anomaly
1.1.1.5.2.5 Open due to lower element	Cover, Cable Tray, TPS Application
1.1.1.5.2.5.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.2.5.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
1.1.1.5.2.5.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.2.5.3.1	Debris Due to MAF Process Training
1.1.1.5.2.5.3.2	Debris Due to Manufacturing Process Plan
1.1.1.5.2.5.3.3	Debris Due to Manufacturing Process Plan - Material
1.1.1.5.2.5.3.4	Debris Due to Manufacturing Process Plan - Acceptance
1.1.1.5.2.5.3.5	Debris Due to External Events During MAF Processing
1.1.1.5.2.5.3.6	Debris Due to Mechanical Assembly Anomaly
1.1.1.5.2.6 Open due to lower element	LO2 Tank C/T Covers & LO2 C/T Fairing Cover, SLA Application
1.1.1.5.2.6.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.2.6.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.2.6.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.2.6.3.1	Debris Due to MAF Process Training
1.1.1.5.2.6.3.2	Debris Due to Manufacturing Process Plan
1.1.1.5.2.6.3.3	Debris Due to Manufacturing Process Plan - Material
1.1.1.5.2.6.3.4	Debris Due to Manufacturing Process Plan - Acceptance
1.1.1.5.2.6.3.5	Debris Due to External Events During MAF Processing
1.1.1.5.2.6.3.6	Debris Due to Mechanical Assembly Anomaly
1.1.1.5.2.7 Open due to lower element	Gap Closures-LO2 Tank C/T, SLA Application
1.1.1.5.2.7.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.2.7.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.2.7.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.2.7.3.1	Debris Due to MAF Process Training
1.1.1.5.2.7.3.2	Debris Due to Manufacturing Process Plan
1.1.1.5.2.7.3.3	Debris Due to Manufacturing Process Plan - Material
1.1.1.5.2.7.3.4	Debris Due to Manufacturing Process Plan - Acceptance
1.1.1.5.2.7.3.5	Debris Due to External Events During MAF Processing
1.1.1.5.2.7.3.6	Debris Due to Mechanical Assembly Anomaly
1.1.1.5.2.8 Open due to lower element	LO2 Tank P/L & C/T Support Bracket, SLA Application
1.1.1.5.2.8.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
1.1.1.5.2.8.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.2.8.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.2.8.3.1	Debris Due to MAF Process Training
1.1.1.5.2.8.3.2	Debris Due to Manufacturing Process Plan
1.1.1.5.2.8.3.3	Debris Due to Manufacturing Process Plan - Material
1.1.1.5.2.8.3.4	Debris Due to Manufacturing Process Plan - Acceptance
1.1.1.5.2.8.3.5	Debris Due to External Events During MAF Processing
1.1.1.5.2.8.3.6	Debris Due to Mechanical Assembly Anomaly
1.1.1.5.2.9 Open due to lower element	Composite Nose Cone, Foam Seal & Blend
1.1.1.5.2.9.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.2.9.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.2.9.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.2.9.3.1	Debris Due to MAF Process Training
1.1.1.5.2.9.3.2	Debris Due to Manufacturing Process Plan
1.1.1.5.2.9.3.3	Debris Due to Manufacturing Process Plan - Material
1.1.1.5.2.9.3.4	Debris Due to Manufacturing Process Plan - Acceptance
1.1.1.5.2.9.3.5	Debris Due to External Events During MAF Processing
1.1.1.5.2.9.3.6	Debris Due to Mechanical Assembly Anomaly
1.1.1.5.3 Open due to lower element	Press Line Barrymounts
1.1.1.5.3.1 Open due to lower element	GO2 & GH2 P/L Barry Mount Slide Cap, SLA Application
1.1.1.5.3.1.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.3.1.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.3.1.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.3.1.3.1	Debris Due to MAF Process Training
1.1.1.5.3.1.3.2	Debris Due to Manufacturing Process Plan
1.1.1.5.3.1.3.3	Debris Due to Manufacturing Process Plan - Material
1.1.1.5.3.1.3.4	Debris Due to Manufacturing Process Plan - Acceptance
1.1.1.5.3.1.3.5	Debris Due to External Events During MAF Processing
1.1.1.5.3.1.3.6	Debris Due to Mechanical Assembly Anomaly

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
1.1.1.5.4 Open due to lower element	ET/SRB Forward Bolt Catcher
1.1.1.5.4.1 Open due to lower element	Bolt Catcher-Forward SRB Separation
1.1.1.5.4.1.1	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.4.1.2 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.4.1.2.1	Debris Due to MAF Process Training
1.1.1.5.4.1.2.2	Debris Due to Manufacturing Process Plan
1.1.1.5.4.1.2.3	Debris Due to Manufacturing Process Plan - Material
1.1.1.5.4.1.2.4	Debris Due to Manufacturing Process Plan - Acceptance
1.1.1.5.4.1.2.5	Debris Due to External Events During MAF Processing
1.1.1.5.4.1.2.6	Debris Due to Mechanical Assembly Anomaly
1.1.1.5.5 Open due to lower element	I/T Fairings
1.1.1.5.5.1	Fairing-LH2 Cable Tray, SLA Application
1.1.1.5.5.2 Open due to lower element	Fairing, LO2 Feedline, SLA Application
1.1.1.5.5.2.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.5.2.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.5.2.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.5.2.3.1	Debris Due to MAF Process Training
1.1.1.5.5.2.3.2	Debris Due to Manufacturing Process Plan
1.1.1.5.5.2.3.3	Debris Due to Manufacturing Process Plan - Material
1.1.1.5.5.2.3.4	Debris Due to Manufacturing Process Plan - Acceptance
1.1.1.5.5.2.3.5	Debris Due to External Events During MAF Processing
1.1.1.5.5.2.3.6	Debris Due to Mechanical Assembly Anomaly
1.1.1.5.5.3 Open due to lower element	Fairing-LO2 Tank Cable Tray, SLA Application
1.1.1.5.5.3.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.5.3.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.5.3.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.5.3.3.1	Debris Due to MAF Process Training
1.1.1.5.5.3.3.2	Debris Due to Manufacturing Process Plan
1.1.1.5.5.3.3.3	Debris Due to Manufacturing Process Plan – Material

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
1.1.1.5.5.3.3.4	Debris Due to Manufacturing Process Plan - Acceptance
1.1.1.5.5.3.3.5	Debris Due to External Events During MAF Processing
1.1.1.5.5.3.3.6	Debris Due to Mechanical Assembly Anomaly
1.1.1.5.5.4	RSS Cross Strap Details, TPS Application
1.1.1.5.6 Open due to lower element	LO2 Feed Line Supports
1.1.1.5.6.1 Open due to lower element	Yoke LO2 Feedline, TPS Application
1.1.1.5.6.1.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.6.1.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.6.1.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.5.6.1.3.1	Debris Due to MAF Process Training
1.1.1.5.6.1.3.2	Debris Due to Manufacturing Process Plan
1.1.1.5.6.1.3.3	Debris Due to Manufacturing Process Plan - Material
1.1.1.5.6.1.3.4	Debris Due to Manufacturing Process Plan Acceptance
1.1.1.5.6.1.3.5	Debris Due to External Events During MAF Processing
1.1.1.5.6.1.3.6	Debris Due to Mechanical Assembly Anomaly
1.1.1.5.7	LH2 C/Ts & Fairings
1.1.1.5.8	Aft C/Ts & Fairings
1.1.1.5.9	Aft I/F Hardware
1.1.1.5.10	Aft Feed Lines
1.1.1.5.11	LH2 Aft Dome
1.1.1.5.12	LH2 Manhole Covers
1.1.1.6 Open due to lower element	MA-25S
1.1.1.6.1 Open due to lower element	Bipod
1.1.1.6.1.1 Open due to lower element	Bipod Struts, TPS Application
1.1.1.6.1.1.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.6.1.1.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.6.1.1.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.6.1.1.3.1	Debris Due to MAF Process Training
1.1.1.6.1.1.3.2	Debris Due to Manufacturing Process Plan

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
1.1.1.6.1.1.3.3	Debris Due to Manufacturing Process Plan - Material
1.1.1.6.1.1.3.4	Debris Due to Manufacturing Process Plan – Shelf Life
1.1.1.6.1.1.3.5	Debris Due to Manufacturing Process Plan - Storage
1.1.1.6.1.1.3.6	Debris Due to Manufacturing Process Plan - Acceptance
1.1.1.6.1.1.3.7	Debris Due to External Events During MAF Processing
1.1.1.6.1.1.3.8	Debris Due to Mechanical Assembly Anomaly
1.1.1.6.2	Nose Cone Closeout (Internal)
1.1.1.7 Open due to lower element	SS-1171
1.1.1.7.1 Open due to lower element	LO2 Feed Line & Supports (External)
1.1.1.7.1.1 Open due to lower element	Feedline-LO2 Aluminum Straight Section Foam Application
1.1.1.7.1.1.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.7.1.1.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.7.1.1.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.7.1.1.3.1	Debris Due to MAF Process Training
1.1.1.7.1.1.3.2	Debris Due to Manufacturing Process Plan
1.1.1.7.1.1.3.3 Open due to lower element	Debris Due to MAF SS-1171 Material Processing
1.1.1.7.1.1.3.3.1	Shelf Life Issue
1.1.1.7.1.1.3.3.3	Contamination During Processing
1.1.1.7.1.1.3.3.4	Improper Surface Preparation
1.1.1.7.1.1.3.3.6	Inadequately Defined Acceptance Testing
1.1.1.7.1.1.3.3.7	Improperly Performed Acceptance Testing
1.1.1.7.1.1.3.3.8	Inadequate Resolution of Identified Anomaly
1.1.1.7.1.1.3.4	Debris Due to External Events During MAF Processing
1.1.1.7.1.1.3.5	Debris Due to Mechanical Assembly Anomaly
1.1.1.7.1.2 Open due to lower element	Feedline-LO2 Flex Sections, Foam Application
1.1.1.7.1.2.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.7.1.2.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.7.1.2.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.7.1.2.3.1	Debris Due to MAF Process Training

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
1.1.1.7.1.2.3.2	Debris Due to Manufacturing Process Plan
1.1.1.7.1.2.3.3 Open due to lower element	Debris Due to MAF SS-1171 Material Processing
1.1.1.7.1.2.3.3.1	Shelf Life Issue
1.1.1.7.1.2.3.3.3	Contamination During Processing
1.1.1.7.1.2.3.3.4	Improper Surface Preparation
1.1.1.7.1.2.3.3.6	Inadequately Defined Acceptance Testing
1.1.1.7.1.2.3.3.7	Improperly Performed Acceptance Testing
1.1.1.7.1.2.3.3.8	Inadequate Resolution of Identified Anomaly
1.1.1.7.1.2.3.4	Debris Due to External Events During MAF Processing
1.1.1.7.1.2.3.5	Debris Due to Mechanical Assembly Anomaly
1.1.1.7.1.3 Open due to lower element	Yoke LO2 Feedline, TPS Application
1.1.1.7.1.3.1	Debris Due to Design Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.7.1.3.2	Debris Due to Vendor Manufacturing/Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.7.13.3 Open due to lower element	Debris Due to Anomalous MAF Processing Resulting in a Cohesive, Shear, Delamination, or Crack Failure of the TPS
1.1.1.7.1.3.3.1	Debris Due to MAF Process
1.1.1.7.1.3.3.2	Debris Due to Manufacturing Process Plan
1.1.1.7.1.3.3.3 Open due to lower element	Debris Due to MAF SS-1171 Material Processing
1.1.1.7.1.3.3.3.1	Shelf Life Issue
1.1.1.7.1.3.3.3.3	Contamination During Processing
1.1.1.7.1.3.3.3.4	Improper Surface Preparation
1.1.1.7.1.3.3.3.6	Inadequately Defined Acceptance Testing
1.1.1.7.1.3.3.3.7	Improperly Performed Acceptance Testing
1.1.1.7.1.3.3.3.8	Inadequate Resolution of Identified Anomaly
1.1.1.7.1.3.3.4	Debris Due to External Events During MAF Processing
1.1.1.7.1.3.3.5	Debris Due to Mechanical Assembly Anomaly
1.1.1.7.2	LO2 & LH2 Covers
1.1.1.7.3	LH2 Feed Line & Recirc Line (External)
1.1.1.7.4	Aft C/Ts & Fairings
1.1.1.7.5	Aft I/F Hardware
1.1.1.8	BX-265

ET 1.1.2 "NON-TPS DEBRIS"

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
1.1.2.1	Debris from Composite Nose Cone and Spike Assy
1.1.2.2	Nosecone Bulkhead Assy
1.1.2.3	IT Access Door Assy
1.1.2.4	GH2 Pressline Fairing Install
1.1.2.5	Presslines and Cable Tray Assy on LH2 tank (aft of XT=1082)
1.1.2.6	LO2 Tank Pressline and Cabletray Assy
1.1.2.7	Aft LO2 Tank Cabletray Fairing Assy.
1.1.2.8	Fwd LH2 Tank Cabletray Fairing Assy.
1.1.2.9	LO2 Feedline Fairing Assy
1.1.2.10	LO2 Feedline Install
1.1.2.11	FOD
1.1.2.12	Aero Vents
1.1.2.13 Open due to lower element	Non-TPS Debris from Other Sources
1.1.2.13.1	Wiring/Electrical
1.1.2.13.3	Internal Components
1.1.2.13.4	Substrate Structure

ET 1. 2 "INTERFACES"

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
1.2.1 Open due to lower element	Structural I/Fs
1.2.1.1 Open due to lower element	EO-1 Fwd Bipod Attach I/F
1.2.1.1.1	Inadequate ICD Design and Implementation
1.2.1.1.2	Inadequate / Incorrect Supplier / GFP Processing
1.2.1.1.3 Open due to lower element	Incorrect/Inadequate MAF processing
1.2.1.1.3.1	Incorrect Part materials Usage
1.2.1.1.3.2	Inadequate Part Processing (Part Marking, Contamination, Shelf Life, Pack and Ship, Etc.)
1.2.1.1.3.3	Incorrect Parts fabrication
1.2.1.1.3.4	Incorrect Parts usage

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
1.2.1.1.3.7	Incorrect NCD Disposition
1.2.1.1.3.8	Incorrect L/C Answer
1.2.1.1.3.9	Incorrect / Deficient Consumables
1.2.1.1.3.10	Incorrect / Inadequate Tooling
1.2.1.1.3.11	Incorrect / Inadequate Inspection
1.2.1.1.3.12	Incorrect / Inadequate Acceptance Test
1.2.1.1.4	Incorrect / Anomalous Ground Processing at KSC
1.2.1.1.5 Open due to lower element	Operational Anomalies (Prelaunch, Ascent, Separation)
1.2.1.1.5.1	Bipod Induces excessive Loads to Orbiter
1.2.1.1.5.2	Bipod Structural Failure imparts anomalous Orbiter load
1.2.1.1.5.3	Bipod Hardware / Components fail and create Debris during Ascent or Separation
1.2.1.1.5.5	Bipod hardware impacts surrounding foam / primary structure
1.2.1.1.5.6	Bipod Anomalous/Incomplete Str. Separation causes I/F hardware to contact orbiter
1.2.1.2	EO-2 Aft Attach, -Y
1.2.1.3	EO-3 Aft Attach, +Y
1.2.1.4	EO-4 LH2 Umbilical Plate (Mechanical)
1.2.1.5	EO-5 LO2 Umbilical Plate (Mechanical)
1.2.1.6	EO-6 LO2 Cross Beam / Orbiter (Aerodynamic)
1.2.1.7 Open due to lower element	EB-1 Fwd SRB Attach -Y & EB-2 Fwd SRB Attach +Y
1.2.1.7.1	Inadequate ICD Design and Implementation
1.2.1.7.2	Inadequate / Incorrect supplier/GFP Processing
1.2.1.7.3 Open due to lower element	Incorrect ICD MAF processing
1.2.1.7.3.12	Incorrect / Inadequate Acceptance Test
1.2.1.7.3.2	Inadequate Part Processing (Part Marking, Contamination, Shelf Life, Pack and Ship, Etc.)
1.2.1.7.3.3	Incorrect Parts fabrication
1.2.1.7.3.4	Incorrect Parts usage
1.2.1.7.3.5	Incorrect Parts Assembly
1.2.1.7.3.6	Incorrect Parts Installation
1.2.1.7.3.7	Incorrect NCD Disposition

ELEMENT NUMBER	*DESCRIPTION OF FAULT TREE ELEMENT*
1.2.1.7.3.8	Incorrect L/C Answer
1.2.1.7.3.9	Incorrect / Deficient Consumables
1.2.1.7.3.10	Incorrect / Inadequate Tooling
1.2.1.7.3.11	Incorrect / Inadequate Inspection
1.1.1.7.4 Open due to lower element	Incorrect / Anomalous Ground Processing at KSC
1.1.1.7.4.1 Open due to lower element	Incorrect / Inadequate Mating
1.2.1.7.4.1.1	Incorrect / Anomalous ET / SRB Mate
1.2.1.7.4.1.1.1	Inadequate Offsite Engineering Requirements (Drawings, Processes, Mod Kits, FECs)
1.2.1.7.4.1.1.2	Incorrect Parts usage
1.2.1.7.4.1.1.3	Incorrect Parts Assembly
1.2.1.7.4.1.1.5	Incorrect AR / PR Disposition
1.2.1.7.4.1.1.6	Incorrect / Inadequate Tooling
1.2.1.7.4.1.1.7	Incorrect / Inadequate Inspection and Acceptance
1.2.1.7.4.1.2	Incorrect / Anomalous Orbiter Mate
1.2.1.7.5	Operational Anomalies (Prelaunch, Ascent, Separation)
1.2.1.8	Canceled (EB-2 Fwd SRB Attach +Y is addressed in 1.2.1.7)
1.2.1.9	Aft SRB Attach -Y (EB-3, EB-5, EB-7)
1.2.1.10	Aft SRB Attach +Y (EB-4, EB-6, EB-8)
1.2.1.11	GUCA (Mechanical)
1.2.1.12	LO2 Vent Hood
1.2.1.13	Post Separation ET / Orb Contact or at ET Break-up
1.2.2	Propulsion Functional I/Fs Functional Performance Impacts Orbiter Systems
1.2.3	Electrical I/Fs Impacts Orbiter / SRB Subsystems
1.2.4	Transportation & Handling I/Fs